ENGINEERING NEWS

THE finding of the Chatsworth crowner's 'quest will do still more, if possible, to sink the jury system in public contempt. It throws the whole blame on the unlucky foreman, who was to blame only as his neighbors were to blame; for the examinations made on behalf of this journal of the track for 15 miles in the vicinity (no one else seems to have thought of looking into this little matter) show that his section was as good as any. Hence the true blame for the condition of the right of way rests with the management. On the other hand not a word is said in blame of the only cause for great slaughter, the utterly needless running of such a mammoth double-header train.

This is even worse than the example of blundering incapacity with the best intentions given in the Bussey bridge investigation, which was rather worse for the public interest than no investigation at all. The moral is, that only under the English system of investigation through trained experts, who have gained skill by experience in this special work, can the public be well served in such matters.

THE most serious railroad accident of the week occurred August 17 on the Baltimore & Ohio Railroad at Washington, D. C. An express train was running into the Baltimore & Ohio depot yard, when the engineer discovered that the air brakes would not act, and whistled for the hand brakes. There was not time to reduce the speed by these means, however, before the train reached the "Y," and the curve was so sharp that the first car left the track, derailed the engine, and smashed into the signal tower. The engine, several cars and the tower were wrecked. The engineer was killed and several persons injured, some seriously.

We give full details of this accident in a letter from a Washington engineer which appears elsewhere. The failure of the air brakes appears to lend new force to the suggestion of a correspondent which appears elsewhere, but we strongly suspect that the "failure" was due merely to the fact that the train was equipped with the old straight-air Loughridge brake which the B. & O. has persisted in using years after there was notoriously a better one in almost universal use. Recently, frightened by the Republic and other accidents, it has contracted to put the Westinghouse Automatic on all its passenger stock, and it would seem as if it must have been in use on this important train, but the change has probably proceeded slowly; it is a way changes have on the B. & O. It was the cradle of American engineering, but if the truth must be said, it has remained such ever since, as some one said of Italy and music.

For this defect of its equipment, if it existed, the B. & O. should justly be held to a strict responsibility, and it might even justify the New York *Tribune's* startling headline of "Murder. not Accident;" but that journal applies its headline to a tissue of misrepresentations in respect to the curve, which it declares to have been "45-degree" instead of the very reasonable radius, for the locality, of 14°. This practice of running trains around a Y has been used at Toledo, O., and elsewhere, for years and is a perfectly legitimate and proper system of operating, to save many trains a needless extra run of a mile or so, and save occupying two main lines instead of one in the heart of the city.

THE following bridge accidents are reported: On Aug. 8 a steam engine, used to run a threshing machine, went through a bridge near Spalding, Mo. One man was killed.——On Aug. 10 two bridges on the Cincinnati, Hamilton & Dayton Railroad were burned, one at Liberty, Ind., the other at Conners, ville. The first was 650 ft. and the second 500 ft. long. ——On Aug. 12 a mixed train on the Evansville & Indianapolis Railroad went through a wooden culvert at Saline City, Ind. The engine and 15 freight cars passed over, but the bridge gave way under the passenger car. Six persons were injured, one fatally. ——On Aug. 12 an iron bridge over the Erie canal at Kline, Montgomery county, N. Y., fell into the canal delaying navigation for a time.

COMMANDER GORDON, who has just made a report to the Dominion Government on his Hudson Bay explorations, carried out with a view to its utility as a commercial route, concludes as follows: That the fish and mammals of this region possess a commercial value and that the Americans now have a monopoly of the whaling there contrary to Canadian rights, but that as a route for ships it is unpromising. It will require specially constructed ships to navigate in the season from July 1 to Oct. 1, the only three months available; and the navigation of Hudson Strait is very difficult, the shores bleak and inhospitable and there is so much magnetic disturbance that the compasses of an iron ship would fail to work.

THE building fund subscription in the American Society of Civil Engineers now amounts to $7,810 as elsewhere announced, with a prospect that a very much larger fund may be secured if the membership proper continues to show an interest in the matter in a substantial way. The sentiment in favor of an entirely new and much larger and finer building is gaining ground, and by a little effort, we feel satisfied, that result will be obtained. One additional subscription of $150 is contingent on such new quarters being obtained.

As a sample of good driving through bad material on the New Croton Aqueduct we have a report from Shaft 12 C, for the week ending July 2. This heading was 8 by 8 ft. inside and 10¼ by 9½ ft. outside timbers. The run was through a material of quicksand nature, top and sides being lagged. Each set of timbers was 4½ ft. long and 3½ ft. were set in 10 hours. In eleven ten-hour shifts 118 lin. ft. of this heading was driven with a force on each shift of one foreman, one carpenter, 4 miners and 5 muckers. The muck had to be wheeled to the shaft in barrows. The work was done by MICHAEL J. NOLAN, who has the contract for the soft ground at this shaft. When the ground is considered this run compares very favorably with 127 ft. of rock heading made in Shaft 16 in fourteen 12-hour shifts.

THE Brooklyn bridge question is dragging its slow length along. The Board of Trustees are waiting for their Committee on "Terminal Facilities" to report, and their Committee are waiting to find some effectual answer to the criticisms of this journal, which so speedily caused a withdrawal of their power "to immediately proceed with construction" and compelled them to submit a new report instead. Naturally it takes them some time to find it.

MR. GLADSTONE has again illustrated that strong good sense and political prescience which makes him easily the greatest Englishman of his generation, and one of the noblest figures in all its history by a speech strongly advocating the Channel tunnel. It is now sufficiently established that for a very moderate sum, and with strong probability of encountering no engineering difficulties whatever, the Channel tunnel can be completed in a few years with certainty of great commercial advantages to England; and there seems to a disinterested outsider something utterly absurd in the notion that 35,000,000 of the race which dominates the world, cannot guard one small hole in the ground so securely that they will at least have time to destroy it before they are driven away from it. If they can merely do that, they are in no more danger from those who may have previously passed through by stealth than they are now from those who may stealthily enter England from over the sea; as they can without let or hindrance. But the strange and the unfamiliar are always terrible, if there be any chance for terror about them, and hence we see that amazing spectacle of a great people which is brave enough in the face of real danger giving way to senseless terror at the thought of a danger which, at the very worst, is not a hundredth part as great as every great people but themselves has lived under from time immemorial, and managed to live through, as long as any greatness was left in them. The *Times*, as might have been expected, has savagely attacked GLADSTONE for his speech, but the permanent victory rests always with the just and the rational, and not with the petty and the bigotted, and the century will hardly close before this tunnel is begun.

AN incident which we commend to the attention of *The Engineer* occurred at the great WHITELEY fire: "Several of the employés and a score of firemen were crossing *a frail bridge* which connected one of the burning buildings with another, when the structure collapsed and threw its occupants down into the street, a distance of 50 ft. Three of the employés and two of the firemen were killed outright. All the others received terrible injuries, some of which, it is thought, will prove fatal." *The Engineer* might perhaps reply that this was not a bridge of "any dimensions," but it is a pretty bad case of bad construction, for the load can hardly have been greater than might have been frequently expected.

WHITELEY'S is the London MACY'S, and is said to have been set on fire six times within about a year, it is supposed by envious minor tradesmen. By a singular coincidence the building next to the office of this journal has likewise been set on fire six times within six months, and has once set the offices below us in the Tribune building on fire and somewhat injured the ENGINEERING NEWS office, but as we have the good fortune to occupy a fire-proof building no harm has resulted. Such instances go to prove what we believe to be unquestionable, that the fire-tax in cities is far greater than would be the cost of fire-proof construction in the beginning. It cannot be many years before the erection of other than fire-proof buildings will be forbidden in the heart of all our cities.

THE experiment of the New York Board of Health, this week, in ridding the streets from the foul smells emanating from upturned and gas-permeated earth, is interesting to other sections. Gas-makers claim that there is a loss of about 20 per cent. due to leakage at the joints in the distribution system. This escaping gas is confined below the surface in great part by the close modern street pavement and thoroughly saturates the soil. Excavating in in this material of course releases this foul-smelling compound, and while it is claimed that this gas is not absolutely injurious to health, opinions differ on this head and complaints are frequent. The Health Department now neutralizes this bad smell in the dirt by a solution of bromine scattered over the piles with sprinkling cans. The effect is almost instantaneous, and in the worst cases a double dose wholly removed the offensive smell.

NEW ORLEANS has commenced the erection of a new tower system which is to conduct all telegraph, telephone and electric light wires high above the roofs of the houses. As the soil is such as to forbid the underground system, water being found 3 ft. below the surface almost everywhere, this aerial system is to be thoroughly tested. The plan includes an iron tower, or braced and guyed post, planted at each street corner street and about 150 ft. high. From the tops of these towers will extend two steel cables ⅝-in. diameter and just below these two or three other cables 1-in. diameter. Between these sets of cables will be fastened upright cross-arms of wood and iron and on these the wires will be strong. A stand-pipe with nozzles at intervals will run up each tower for the use of the fire department.

THE week has seen a very interesting and largely attended gathering of the American Association for the advancement of Science in this city, at which a very large number of papers relating to scientific matters of all kinds were read, as elsewhere more fully summarized. Perhaps the most important paper to Engineers was that by Mr EDISON on the generation of electricity direct from heat, a topic of vast potential importance, since even a fair solution of that problem will speedily displace the steam engine, with its scant utilization of 3 to 10 per cent. of the energy in coal, which even in theory cannot be more than 17 per cent. But the truth must be admitted that although Mr. EDISON reported what seems to be important progress, no approach even to this limit as yet seems probable, which strongly indicates that the investigators are proceeding on false lines; for everything we know of energy points directly to the fact that heat and electricity are in some way directly interconvertible.

AT the Manhattan bridge, across the Harlem river, the west main pier and the west arch piers are well up and centers are being placed for one of the approach arches. The center main pier is practically completed above the springing-line, and the east main pier is finished above the spring, and the east approach piers are nearly ready for the arches. False works are being set up for the east main or shore arch, and quite a quantity of the metal work for this arch is already on the ground. The steel pedestal plates for this span are being placed in position. The Passaic Rolling Mill Company, the contractors for the metal work, expect to be ready for raising this first arch in about two weeks.

THE Martin Anti-Fire Car Heater Co. of Dunkirk N, Y. has signed a contract to equip all the cars of the New-York Central & Hudson River Railroad with their systen of steam heating. The contract will involve an expenditure by the Central of over $600,000. By the Martin system of car heating live steam is taken from the locomotive by means of a reducing valve, which keeps the pressure in the pipes at about 5 lbs. per sq. in. or less. The steam is conveyed through the cars by ordinary steam pipes. The connection between the pipes. which has always been the most difficult part of the problem, is made by a metallic ball and socket joint, so ground that it is steam-tight and yet will conform to all the motions of the car. This joint has given a very good account of itself. but it is the weak point of this as as of all other systems. In fact, it is the only serious part of the problem, although there may of course be great choice in the way of distributing the heat.

THE London *Times* sayes that a Belgian syndicate has obtained a consession for a railway from Teheran to Meshed, in Persia, and is maturing plans for construction. This is part of the line projected by the English some time ago, from Scutari to Quetta, and thence to Sukkur and India, of which we will have more to say next week. Meshed seems to be just now a common objective point, the Russians are already rapidly building in that direction from Merve—"for the accommodation of the pilgrims." As it is only 200 miles from Meshed to Herat through a country very favorable for railway building, some other nation may get there yet before England. The Belgian consession, if correctly reported, would be a good thing in itself, as it would open up about 800 miles of the richest territory in Persia. But as one end would be on the Caspian Sea and the other connecting with a Russian railway system the Shah might find himself uncomfortably near to being "hugged by a bear". England had better invite proposals from some American railway builders if she really wants to get ahead of her very aggressive rivals.

The St. Clair Tunnel.

The new St. Clair double-track tunnel on the Pennsylvania Schuylkill Valley Railroad, is located about 1¼ miles west of Pottsville and near the Borough of St. Clair, Schuylkill Co., Pa. The tunnel is 750 ft. long between facades, is built for double track, and arched with brick throughout except a short distance at each end. It took 11 months and 15 days to build it. This was longer than it should have been and was caused by several reasons; one of them being that the tunnel was started single track and carried on so for a distance of 99 ft. at the east end and 122 ft. at the west end. Timber bents, as shown in section, Figs. 1 to 4, placed 5 ft. apart on an average, were carried along to support the roof. The timber was intended to act as a permanent roof. The tunnel was to be 16 ft. wide when completed but the average width was but 14 ft. when the change from single to double track was commenced. The rock was hard but very treacherous, and it lay with an incline of 40°. Consequently there was more pressure on one side than the other. This heavy inclination accounts for the high roof in the section.

A number of small coal veins, varying from 6 ins. to 2 ft. in thickness, were encountered. The coal was soft and mushy, and thoroughly saturated with water. Frequently these veins were found to be below the heels of the rafters or legs of the timber bents. The coal and water would squeeze out, by the heavy weight above, and thus let down the bent on that side, and the result would be the destruction of the timber roof or a heavy surge of the bent laterally. It was found necessary to put iron clamps at the shoulders of the bents to prevent them from collapsing when a settlement or uneven pressure would occur at one side. The pressure caused by the squeezing out of these coal seams was so great at the west end, that when double track excavation was carried on, the timber bents (segmental) were placed against one another and carried to the subgrade, for a distance of 60 ft. The strata of rock were about 3 ft. thick, and generally had mud seams between.

These mud seams made the work extremely difficult and dangerous, and required great care and watchfulness. On one occasion an overhead rock point was thoroughly sounded in the usual way, and it was pronounced perfectly safe; nevertheless, a timber prop was placed underneath to assure the workmen. The next day (Sunday) a number of visitors were shown the workings of the heading and walked under this rock, and experts pronounced it safe and were pleased with the care taken by the contractors for the safety of the workmen, yet the next day (Monday) this rock fell down and killed one workman and wounded several others. It weighed 15 tons and was backed by a mud seam. The rock was so large and solid that in sounding, when in place, no hollow sound was produced. These mud seams existed throughout the tunnel and no dependence could be placed on the roof, no matter how it looked or sounded.

The tunnel excavation for single track was started Dec: 3, 1885, at both ends. After the progress above stated the company very wisely decided to build a double track tunnel. In February, 1886, double track excavation was started at the inside end of the single track excavation. It was not long before it was discovered that the single track portion was a perfect nuisance, as it acted as a "gauntlet" in the way of getting cars in and out of the tunnel and very materially interfered with the rapid excavation of the double track tunnel inside. It was quite a problem how to enlarge the existing single track tunnel without blocking the "gauntlet," and thus interfering with the excavation inside. It was once decided to blow out one bent at a time, let the loose material fall down, then enlarge to double track and timber. This plan was not carried out on account of the risk attending it, and besides it would have thoroughly choked the gauntlet.

The plan agreed on, and subsequently successfully carried out, was to commence on the top of the outside end of the single track timbering and drive a narrow gangway (about 6 ft. wide and 6 ft. high) the full length of the single track timber, then widen out laterally on both sides at the same time, and erect the segmental timber for double track at its proper place, below the temporary timber. The top of the timber or lagging for double track required to be placed 3 ft. 4 in. above the top of the single track, but as this was a very narrow space to

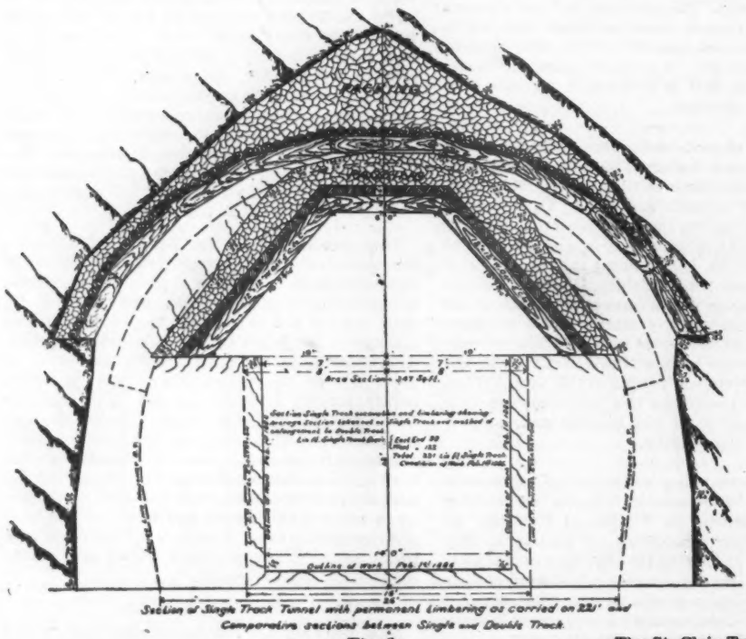

Section of Single Track Tunnel with permanent timbering as carried on 22½' and
Comparative sections between Single and Double Track.

Fig. 3.

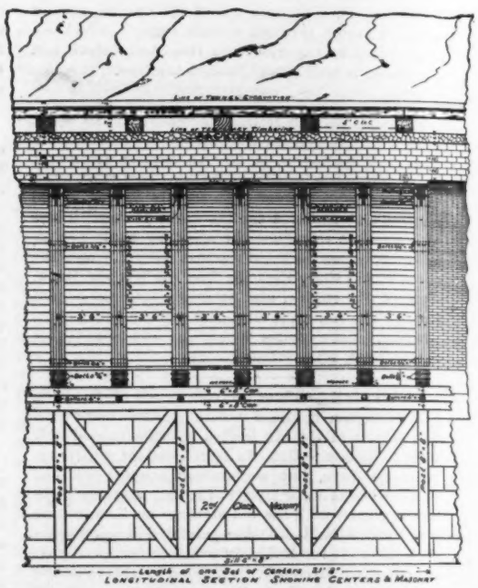


Fig. 4.

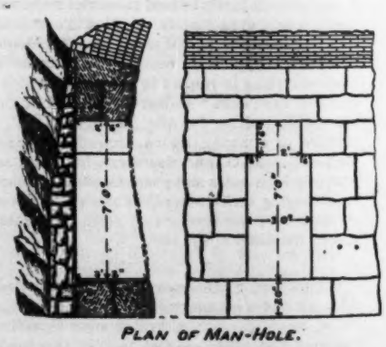


Fig. 8.

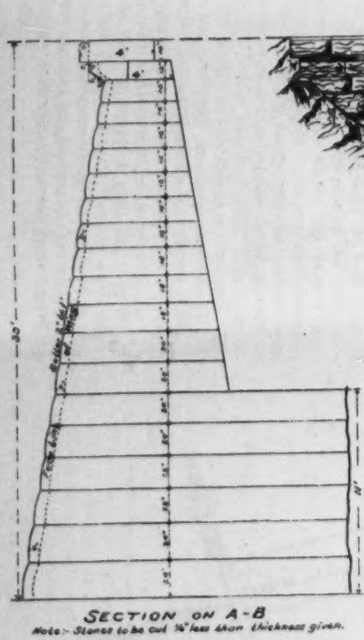


FIG. 5.

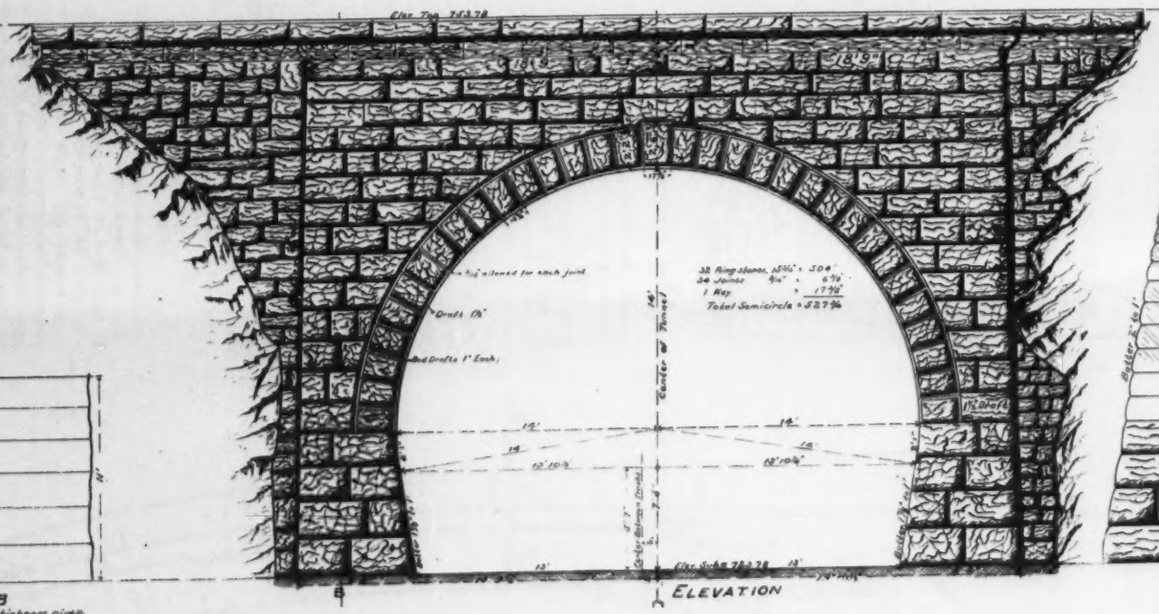


FIG. 6.—ELEVATION OF WEST PORTAL.

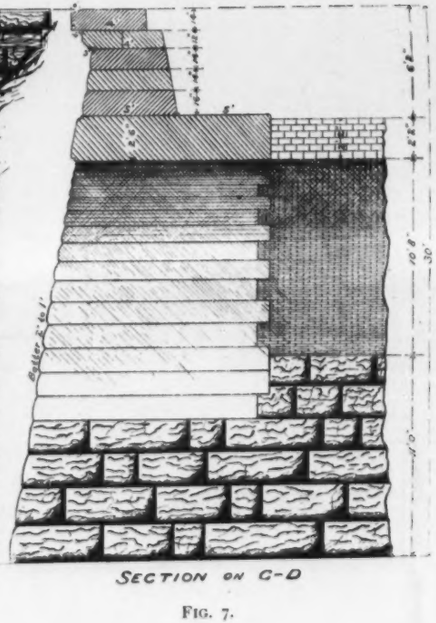


FIG. 7.

St. Clair Tunnel,

P. S. V. R. R.

(Near Pottsville, Pa.)

P. F. BRENDLINGER,
Engineer.

DRAKE, STRATTON & CO.,
Contractors.

1886.

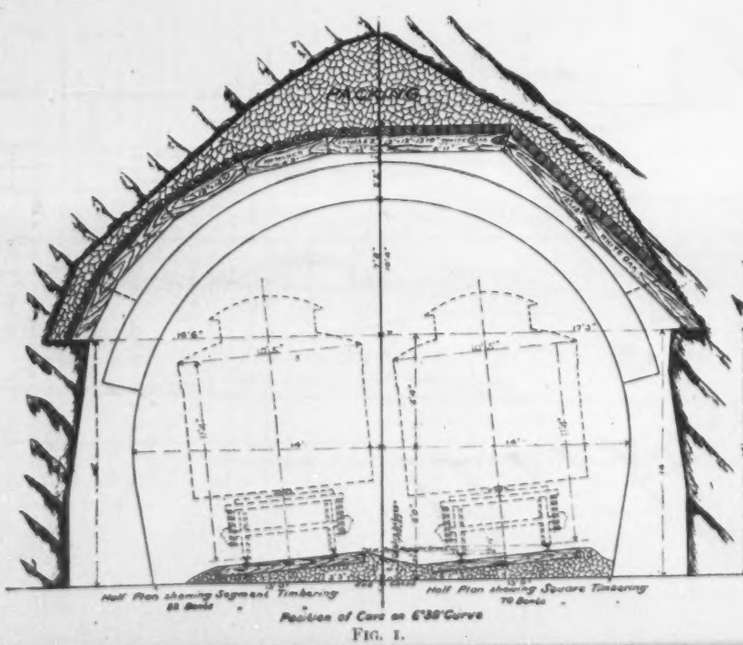


FIG. 1.

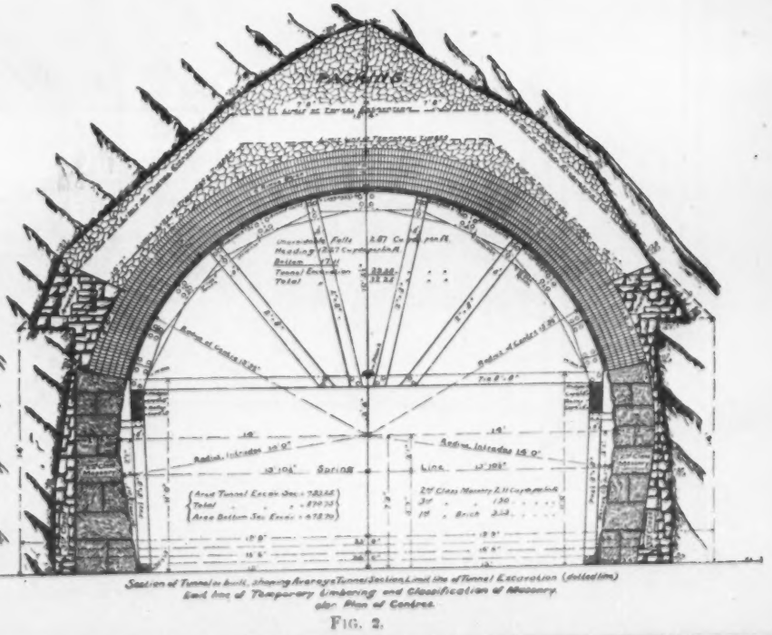

PACKING
Section of Tunnel as built, showing Average Tunnel Section, Limit line of Tunnel Excavation (dotted lines)
Limit line of Temporary Timbering and Classification of Masonry.
also Plan of Centres.

FIG. 2.

work in, a 6 ft. high excavation was made, then packed above the permanent timbers. After all the material was excavated above the single track timber, and double track timber placed, the single track timber was removed at times when it would least interfere with the running out of the material from the interior. The side benches of rock were also blown out and material removed when the best opportunities occurred.

There is no question that had the tunnel been started double track originally, two months' time could have been saved in the progress of this tunnel. The headings were mostly driven with steam drills, (Ingersoll), and fans driven by hand supplied fresh air at the face, but the last 200 ft. in the heading were driven by hand, the steam making it too hot for the men. Tallow dips were also used in the last 200 ft. as the heat from the naptha lamps made it too warm, and vitiated the air. Of course compressed air should have been used with the Ingersoll drills, and all heat troubles would have been avoided.

BILL OF MATERIAL FOR CENTERS.

MATERIAL FOR ONE CENTER.

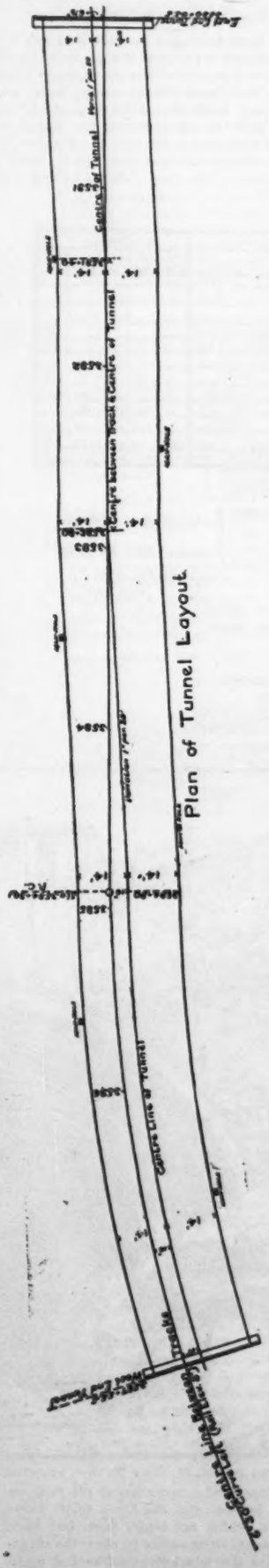
No.	DESCRIPTION		FT. B.M. W. Oak	FT. B.M. Hemlock	LBS. Iron
6	Rib Pieces	2" x 14" x 6' 1"	85		
10	" "	2" x 14" x 6' 1"		142	
4	" "	2" x 11" x 3' 1"		23	
4	" "	2" x 11" x 1' 7"	12		
4	Braces	2" x 8" x 10' 8"		58	
4	"	2" x 8" x 11' 2"		60	
1	Tie	8" x 8" x 26' 10"		143	
28	Bolts ¾" o [11"]				56
28	" ½" o [11"]				17
	TOTAL FOR ONE CENTER		97	426	73
	MATERIAL FOR ONE SET OF CENTERS.				
7	Centers, placed 3' 6" C. to C. (13 sets)		679	2982	511
14	Posts	8" x 8" x 8' 2"		609	
6	Caps	6" x 8" x 22' 0"		528	
4	Sills	6" x 8" x 22' 0"		352	
73	Logging	2½" x 6" x 22' 0"		2008	
	TOTAL FOR 1 SET OF CENTERS.		679	6479	511

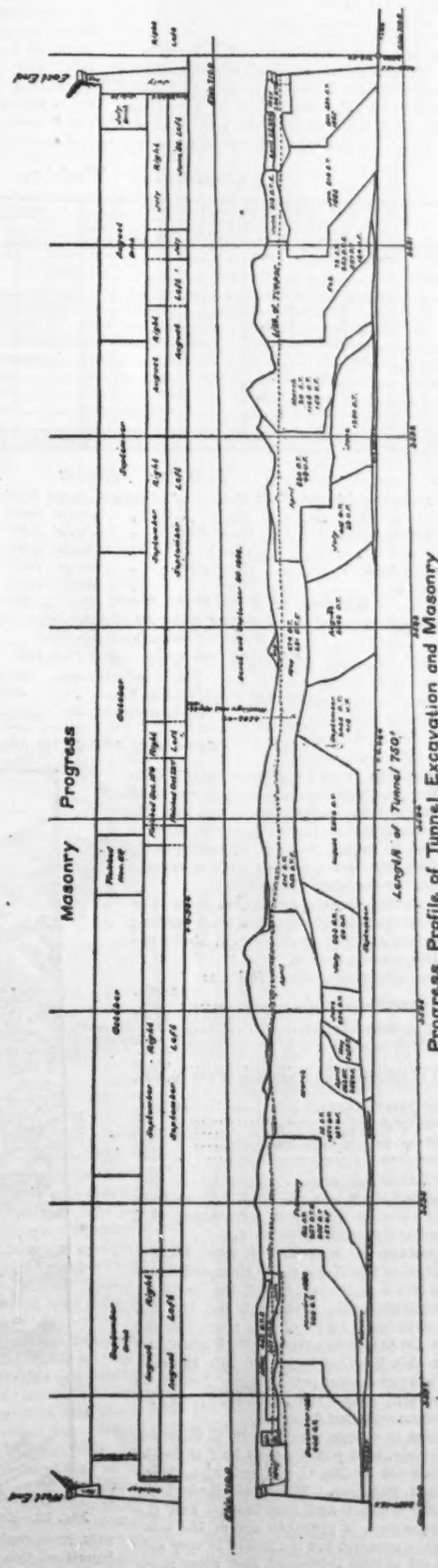
Different kinds of timbering were used, the contractors not being compelled to use any particular method, so that it was made safe. The segmental was exclusively used when once adopted, and it gave the best results by far. No timbering was removed when arching, as it was deemed unwise to do so. The timber when it decays will let down the roof so gradually that no harm can come to the arch, besides, the haunches of the arch are built up with solid masonry to a height of 5 ft. above the base of the brick arch, and dry stone packing, well rammed in, fills all the spaces above.

The tunnel is built the same size throughout in section, on curves the same as on tangent, but the center of the tunnel does not coincide with the center of the track. It was ascertained that practically the eaves of the car leaned just double the elevation on the outer rail; therefore, after determining the proper elevation of the rail the tunnel was shifted just double that distance to give equal clearance for the cars on both sides of the tunnel. The sketch on detail plan, Fig. 3, shows this very nicely.

MASONRY.

The side-walls were built of second class masonry, the rock from the tunnel excavation being used. This was carried up 11 ft.; then six half rings of brick arch were turned. As soon as the brick arch was keyed, the wedges under the centers were slightly struck to permit a pressure on the cement joints. In ten hours afterwards the wedges were entirely removed and the centers moved forward in position for the next length of arch. Expert bricklayers laid as high as 3,000 bricks in ten hours. The average was over 2,000. Manholes alternating 100 ft. apart were built in the sidewalls as shown in Fig. 8. Water courses or seep holes were put in every length of brick arch at the top of cemented backing, 5 ft. above the base of the brick arch, but they do not amount to a "pinch of snuff," as the water generally comes through everywhere else but there. In fact, the writer has long ago discovered that water percolates through the brick and cement regardless of the seep-holes.





Figs. 10 and 11—St. Clair Tunnel.

QUANTITIES.

The excavation in the tunnel was divided under three different heads:

1st. Tunnel excavation proper.
2nd. Unavoidable falls.
3rd. Enlargement from single to double track.

Tunnel excavation embraced all the material inside of fixed lines. Material outside was called unavoidable falls. The contractor, of course, did not try to have more unavoidable falls than was possible, and he did not try to do his blasting reckless or carelessly so as to get unavoidable falls yardage. The price for unavoidable falls was fixed after the work was started, and only paid for removing the material, and as no price was paid for packing above or behind the arch, all spaces made by unavoidable falls cost to pack as much as or more than the price for removing the material.

Enlargement from single to double track was composed of all material above single track heading whether timber, packing or solid rock, above the heel of the single track timber.

The different quantities were as follows:

	cu. yds.
Single track excavation	2,841
Double " "	17,842
Double track enlargement	2,022
Unavoidable falls	1,481
Total	24,186

Tunnel 750 ft. long makes an average of 32.2 cu. yds. per lin ft.

Masonry Quantities.	cu. yds.
1st class masonry (ends)	482
2nd " " side walls	1,466
3rd " " behind side walls	1,349
Brick arch	2,348
Total.	5,645

or an average of 7.53 cu. yds. per lin. ft. There were 3,800 barrels of cement used, or an average of 1 barrel cement to 1.49 cu. yds. masonry.

The contractors for this tunnel were DRAKE, STRATTON & CO., of New York, at the start, and it was managed by Mr. I. A. HODGE, one of the partners. Mr. HODGE subsequently withdrew, and Mr. ED. KELLEY, of Pottstown, Pa., took his place, and the firm became DRAKE & SRATTON, with Mr. KELLEY as Manager. Mr. KELLEY had with him the celebrated and veteran tunnel man "MIKE" NOLAN, as General Foreman, also "JIM" DONOVAN, "PAT" DARCY and other excellent foremen.

The engineers in charge were Mr. H. E. TRIPLER, Division Engineer, who put it about half through, and was succeeded by Mr. C. S. CHURCHILL, Principal Assistant Engineer. The work throughout was extremely difficult and treacherous, and the tunnel as completed is probably one of the most expensive in the country, but the result is very satisfactory to all parties interested, and what more can be desired?

This journal is indebted to Mr. P. F. BRENDLINGER, Chief Engineer of the P. S. V. R. R., for the above description and the illustrations for the same.

Quantity Table

	WEST END TUNNEL Exc.					EAST END TUNNEL Exc.					BOTH ENDS					MASONRY				
	S.T.	D.T.E.	D.T.	U.E.	Total Yds.	S.T.	D.T.E.	D.T.	U.E.	Total Yds.	S.T.	D.T.E.	D.T.	U.E.	Total Yds.	1st Class	2nd Class	3rd Class	Brick	Total
Dec. 1885	648				648	334				334	982				982					
Jan. 1886	799				799	819				819	1618				1618					
Feb. "	133	267	965	137	1502	73	263	527	186	1197	206	530	1492	323	2699					
Mar. "	15		1277	137	2129	20		1168	158	1347	35		2445	295	3476					
Apr. "		14	563	288	865		56	820	49	934		69	1383	337	1799					
May "		442	518		960		291	674		965		743	1192		1935					
June "		287	620		1077		313	1280		1593		700	1900		2670		86	20		106
July "			993	60	1053			916	23	445			1909	83	1498	162	112	80	97	458
Aug "			2868		2868			2202		2202			4262		4262	71	334	280	328	1073
Sept. "			1531	196	1727			904	232	1136			2435	418	2863		798	500	831	2129
Oct. "			226		226			283		283			497		497	249	76	469	1023	1179
TOTAL	1595	1110	9578	838	13121	1246	912	8263	643	11064	2841	2022	17842	1481	24186	482	1466	1349	2348	5645

Tunnel Data

Masonry (Bench Wall) East End started June 22nd 1886 } Closed Oct. 15th 1886
" " " West " " July 28th "
Brick Work East End " July 20th " } Closed Nov. 6th 1886
" " West " " Aug. 30th "
Facade East End " July 10th " Completed Aug 7th "
" West " " Oct. 13th " " Nov. 19th "

Closure of Brick Work made at Sta. 3594+39.5

Headings started Dec. 3rd 1885, met 12.15 A.M. May 26th 1886.
Bench out Sept. 8th 1886.

Total Masonry 5645 Cu. Yds.

Cement used { N.Y. and Rosendale 1000 Bbls. / Hudson River " 600 " / Improved Union 2200 " } 3800 Bbls.

1 Cement to 1.49 Cu. Yds. Masonry

The Chatsworth Disaster.

Little has been developed to modify in any way the brief summary of the facts of this great disaster which we gave last week. The photographs taken so far as we have been able to secure them, were very poor, and omit the most important and interesting view to an engineer, the status at the wrecked structure itself and the distance by which it was separated from the wreck. This is sufficiently given in the two subjoined letters, however, from engineers who investigated the facts on behalf of this journal, and the three small views which we give (which are copies from but little larger photographs) alone suffice to show the singular way in which the wrecked cars bunched up in front, telescoped into each other, and separated from the rear sleepers, which were probably held by the automatic brakes at just the right moment to prevent further loss of life. The true lesson of this disaster, as we have noted elsewhere, is the terrible consequences of running abnormally long double header passenger trains. The "View from the East" shows in a very interesting way how the second engine and tender worked together to make a complete barricade, against which the terrific force from behind could crush the leading cars.

We are as yet compelled to suffer from an embarrassment of riches as respects the exact plan of the structure. Both of those we give were sent us by engineers in whom we should have had confidence; both of them were probably hastily prepared, and largely by hearsay, since the structure was almost completely burned up and the banks much disturbed by the wreck and subsequent events. We are inclined to put most confidence in the larger sketch, as it is given with more detail than the other, and corresponds most correctly with an average of the wildly varying descriptions, as also with probability. A day or so after the accident the banks were probably so disturbed as to make the smaller sketch a natural mistake. The ties were oak, and had 3-in. or 4 in. plank been substituted for the pile of old ties behind the bents, the structure would have corresponded with standard practice on many roads. The whole difficulty seems to have arisen from negligence in guarding against fire in a time of excessive drought, as experience has shown that such structures are not in themselves dangerous nor a frequent source of accident. The following letters seem to give all further information.

CHAMPAIGN, Ill., Aug. 13, 1887.

EDITOR ENGINEERING NEWS:

Your telegram was not received until Friday. I immediately proceeded to the scene of the disaster, as requested. All information enclosed is based upon personal investigation. Recognizing the responsibilities of a publisher, I have sought to have every statement strictly correct. It seems a brief putting of a great disaster, but the cause was very simple—almost insignificant—but the effect!

Yours truly, I. O. BAKER,

[Prof. BAKER's letter was accompanied by the

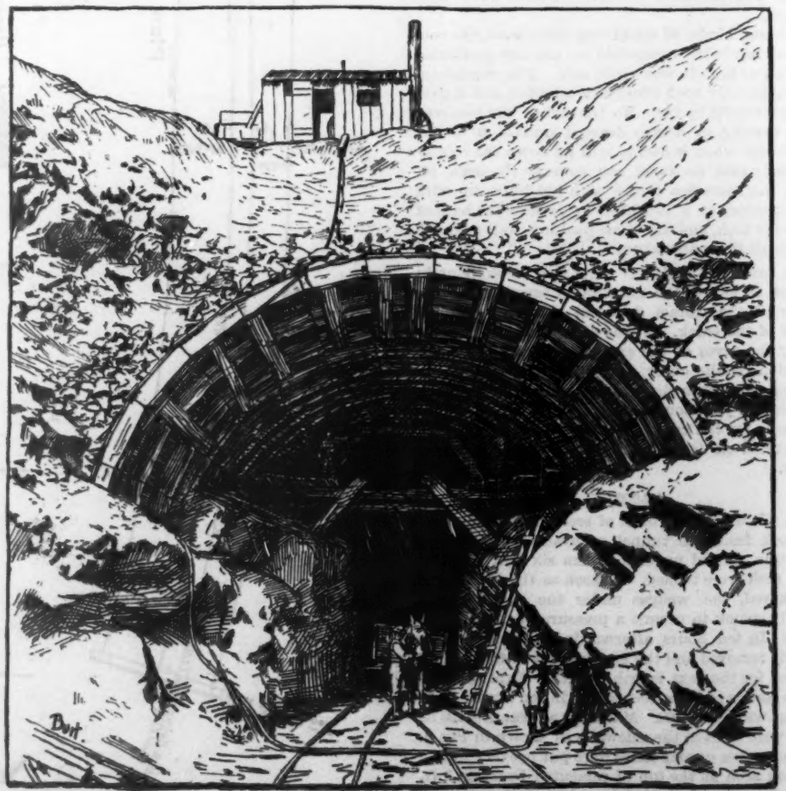
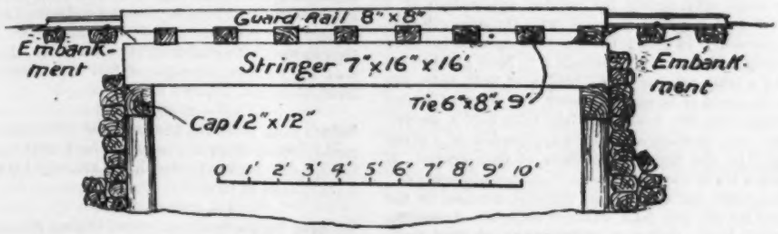


Fig. 12.—East Portal, St. Clair Tunnel, showing full-size enlargement from single to double track.

following article, which gives about all that is ever likely to be definitely known.—ED. ENG. NEWS].

A Niagara Falls bound excursion train from Peoria on the Toledo, Wabash & Western road, plunged through a burning culvert, 2½ miles west of Chatsworth, Ill., about midnight on August 10. There were a few more than 600 persons on board, of whom 71 were killed outright, and two have since died of injuries received, 129 were so seriously wounded as to occupy couches, and about 250 were slightly wounded; the total being 73 dead, and 374 wounded, or 447 more or less injured. Four or five of the wounded are not expected to live, and one or two are still unaccounted for.

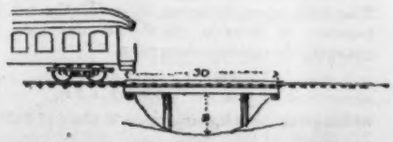
The train was a double-header, made up as follows, in order from the front: baggage car, private car of general superintendent, six day coaches, two chair cars, and six Pullman sleepers. The culvert was an ordinary two bent pile trestle, 15 ft. span



The Chatsworth Trestle before the Accident.
(See note to smaller sketch.)

and 6 ft. high, in a 4 ft. embankment. The grade from Chatsworth east is a succession of small undulations, with a slight general descent for a mile and a half before reaching the scene of the disaster. From the fatal culvert the grade for about 1,800 ft. each way is 25 to 30 ft. per mile. The line is perfectly straight. The engineer of the head locomotive (the other was killed) testified that he was running 30 miles per hour; intelligent and experienced passengers place it at 40. As the train was on a descending grade, two hours late, and the engineer, as he stated, trying to make up time, the latter figure is probably more nearly correct.

The culvert seems to have been nearly consumed before the excursion train approached it. The engineer of the leading locomotive saw a fire under the bridge when he was about 200 ft. distant. He reversed his engine, and according to the testimony of



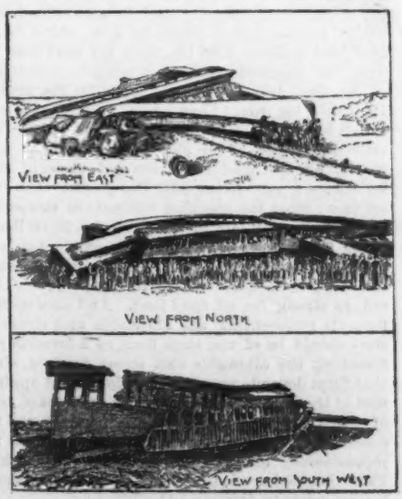
The Chatsworth Trestle before the Accident.
(According to sketch sent by A. H. BELL, City Eng., Bloomington, Ill., showing position of front sleeper. We deem this sketch of structure less reliable than our larger sketch, which was from notes of another correspondent taken on the spot.)

the general superintendent, who was in his special car, the second engineer immediately thereafter applied the automatic air brake. After the crash the first engine was found on the track about 250 ft. from the east end of the culvert, and the tender also on the track about 50 ft. back of that. The second engine was thrown on its side on the south side of the track (see View 1). The baggage and special car were across the track. (View 1) Seven passenger cars were piled one upon top of the other on the track immediately to the west. (See View 2). The forward tracks of the first sleeper rested over the culvert. The debris of the nine cars and the engine occupied a little less than 180 ft. The water-way was filled with trucks. No one was seriously hurt in the baggage or special cars, and no one was injured in the sleepers. No part of the wreck burned, owing to the heroic efforts of passengers and citizens, and the rain which set in about an hour after the disaster.

The accident occurred about midnight. Ample evidence was introduced at the coroner's inquiry to show that a general inspection of the track and bridges had been ordered, as a special precaution for the excursion train. The bridge engineer inspected the culvert from the rear end of a car at 4 o'clock of the day of the accident. The section men claimed to have inspected it between half past five and six o'clock of the afternoon before the accident, but of this the evidence is not conclusive. They had been burning weeds near the trestle late in the afternoon. The hand car had been left near the bridge and the evidence before the coroner, although conflicting, seems to show that they did nothing more than push the the car over the bridge on their way home from work. The bridge engineer's special was the last train over the culvert, and the fire appears to have originated either from sparks from this train or from the fire set by the section men, probably the latter.

On the other hand, the railroad men claim that about three weeks before the grass under and around the culvert had been cut away for 10 ft. from the timber, and the surface shovelled back for 3 or 4 ft. An inspection of a dozen or fifteen similar structures adjacent shows that they had been so treated. However, the work had not been as carefully done as the season and the decayed condition of the bridge timbers and ties would demand.

A theory that the bridge was set on fire for the purpose of robbing the train seems to have originated with the railroad officials, and been given to



Views of Chatsworth Wreck.
(Train was running east. North should read South in View II.)

the public through the Associated Press agent. The theory finds no believers and has no show of reason. The fire was seen from the Chatsworth depot from 8:30 until train time by a number of persons and commented upon; to be visible at that distance would require that the blaze should extend at least 5 or 6 ft. above the track. Train robbers would have found a better and safer way of destroying the bridge. No citizens could be found who had seen any suspicious strangers about, as claimed.

The road was wrecked by the Wabash combination and was taken out of the hands of a receiver July 1, 1887, all officers and men being retained in their former positions. The road is in a very poor condition; the track is over-grown with weeds and grass, the ties are badly decayed, the surface and alignment of the rails is bad, the road has but little rolling stock and the most of that is in poor condition. On the other hand, the equipment of the excursion train seems to have been as good as the average. The President of the road asserts that the brake apparatus was specially tested at Peoria, and also at Forreston 6 or 8 miles west of the place of the accident. The brakes of the sleepers had to be "bled" before the cars could be moved. The culvert was just like thousands of others in this region. It failed only because of the fire. The piles and the timber of the end walls were decayed somewhat, but not enough to seriously weaken the structure. The stringers, ties and guards had been in place about 14 months. The ties were the usual oak ones.

The road should be censured (1) for seeking to economize by running a double header, (2) for not taking greater care to protect wooden structures against fire, (3) for carelessness in bridge inspection.

An inspection of the wreck, and a study of the description of the injuries, forcibly suggest that some better form of constructing passenger cars is sadly needed. The broken and splintered ends of the car timbers materially added to the casualties In this case there was a very narrow escape from the added horrors of burning.

I. O. BAKER.

Office of City Engineer,
BLOOMINGTON, Ill., Aug. 12, 1887.

EDITOR ENGINEERING NEWS:

I have not seen the site of the great Chatsworth wreck in person, but send you a few reliable facts, which may be of interest, obtained from a witness at the place, who is himself an engineer. The accident occurred in the County of Ford, Ill., about 3 miles east of Chatsworth, and about 3 miles west of Piper City. Of the culvert I send you a small sketch. It was a small affair, originally about a 30 ft. opening, 2 bents, approached at either end by an embankment of 7 or 8 ft. elevation. The track at this place was not ballasted with any other material than earth. The train came from the west and approached the culvert on a grade of about 35 ft. per mile.

At or near the culvert the grade begins to ascend to the East. The timbers of the culvert are considerably burned or charred. The grass is burned away around the culvert for 50 or 60 ft. No water in the ditch, ground quite level surrounding the scene of the disaster. The first engine passed over safely, but lost its tender, the second engine lay about 100 ft. east of culvert on south side, track, and its tender on north side both totally demoralized; the culvert was totally obliterated, and the opening filled mostly with trucks, which were literally scraped off of the coaches as they were forced over the culvert opening. The coaches then telescoped in all directions, laying on both sides of the track, one rail was bent around as shown in sketch on the south side of the track, seven day coaches were destroyed. No sleepers left the track, the first sleeper just tipped slightly into the culvert opening.

Yours truly, A. H. BELL, City Engineer.

[By a second letter Prof. BAKER reports as follows: ED. ENG. NEWS].

After further reflection it seems almost certain that the burning of the culvert was caused by fire left by the section-men when burning weeds. Remember that the section men testified that they had been burning weeds "25 to 40 rods east of the bridge," at 5 to 5½ o'clock P. M. In the afternoon the wind was blowing from the south-*west*. Remember also that after the crash, the wind was blowing from the south-*east*; so that the wreck (2 in sketch) did not catch fire from the burning bridge. Now an inspection of the line from Chatsworth to Gilman shows that in burning the large crop of swamp grass along the right of way, many patches and fringes had been left. The foreman testified to finding weeds on fire near the bridge early in the afternoon, which he extinguished, yet he claims to have burned these before. The Chatsworth section was the worst, in the matter of burning weeds, of the three that I inspected. In a number of cases, (say 3 or 4 out of 12 or 15 examined) grass and weeds were left near wooden culverts which *could have* communicated fire to the structures. Some such patches, and fringes and patches in the neighborhood of the wreck, may have been the means of carrying the fire left by the section men to the fatal trestle. (They testified that they "may have left some 'smokes'") Possibly the igniting sparks may have come from the locomotive of the train carrying the bridge in

spector, which passed the wreck at 4 o'clock in the evening.

The bridge engineer inspected (?) the bridge from the rear of a freight train, which, under the circumstances was no inspection at all.

Fire was the only danger to which the bridge was then exposed. There was but little, if any, danger of the ties (new oak) burning. The wooden retaining walls and the piles were considerably decayed the surface being like tinder—but could not be seen from a car platform. It is possible that the piles or wall could have been on fire at the time of his inspection and he not have seen it.

Before the coroner the section men seemed to desire to convey the impression that one of their number had looked under the bridge but none would testify that they looked under the bridge or saw any one do so. Yours very truly,

I. O. BAKER.

The New Method of Dimensioning.

ANN ARBOR, Mich., Aug. 3, 1887.

EDITOR ENGINEERING NEWS:

The fact that Prof. CAIN's formula (1) fails in one of the critical limits is of such importance that it is worth while to inquire what intrinsic value there is in the defence given therefor. One reason given for straining hangers less than counters is because hangers "probably receive more direct shock than a counter, which is generally taut, whereas a hanger may not be." A second reason given is that the "breaking of a hanger is a more serious matter than the breaking of a counter; for in the first case the bridge is undoubtedly wrecked, whereas in the latter case, the stiffness of the upper chord and bracing may prevent a catastrophe." In answer to the first of the above reasons, it may be said that a counter is slack *every time* a train passes over the bridge, and hence should be strained less than a hanger, which is taut all the time except under special circumstances, and then only in cases of gross neglect. In answer to the second of the above reasons, that in case of the failure of a counter the stiffness of the upper chord and bracing *may* prevent a catastrophe, I would ask, Is it wise, is it safe, to trust to luck in this matter? We *are* trusting to luck when we allow a higher unit strain on counters than on floor-beam hangers, because a breakage of the latter *must* produce a catastrophe, whilst a breakage of the former *may not*. Our great endeavor in designing bridges is to eliminate all possible secondary strains, one endeavor being made by Prof. CAIN in his remarks when he proposes to make the top chord hinged at panel points; and yet when an accident occurs, we are to trust that those secondary strains will save the bridge. It is very questionable, however, whether secondary strains would not come as much to our aid in case of the failure of a hanger as of a counter. It is uncertain whether Prof. CAIN would also allow an addition of 25 per cent. to the end vertical suspenders of a Pratt or Whipple truss with inclined end posts. From his remarks and from standard practice it is inferred that he would. In specifications adopting his formula it would, therefore, be necessary to add this exceptional case also, and in other varieties of trusses other exceptions would have to be made; exceptions the more important, because they are likely to pass unnoticed on account of their infrequent occurrence.

As I pointed out in article I. the formula of Prof. CAIN will in nearly every case produce a lighter bridge than standard specifications. This being so, the question arises, have we any reason to believe that American bridges have been, and are being, built too heavy? I believe that the experience of every engineer will lead him to answer this question at once in the negative. Of course, the weakness of existing bridges is in part due to the increase in rolling load, in this country especially; but that it is also due in part to the allowable unit stress being too high is the basis for formula (*A*). The fact that American bridges are noted all over the world for their lightness *for the loads they are designed to carry* appears to me to show conclusively that this second cause for weakness exists. Of course it may be said that there is less waste of material in pin connected bridges than in riveted bridges; that the greater depth of American bridges gives greater economy than the shallower European bridges, but to offset these causes for lightness is the fact that the greater dead load, due to waste material and ballast of European bridges would allow a higher unit stress than in the more economical American structure. Yet we never hear of any tendency in Europe to increase the allowable unit stresses; in fact experience has made engineers there as well as here to continually reduce those unit stresses.

Formula (*A*) does not profess to provide for any increase in rolling loads in the future, but if an increase does take place, and there is every reason to believe it will. The dotted line marked (*A*) on diagram, page 310, vol. XVII, will show for a particular case how much better able it is to stand the increase than those formulæ given allowing higher unit strains.

The formula of Prof. CAIN allows 15,000 lbs. for all dead load, as formula (*A*) does. Now scientists, and I might almost say practical engineers, generally agree with RANKINE when he says that "a bar to resist with safety the sudden application of a given pull, requires to have twice the strength that is necessary to resist the gradual application, and steady action of the same pull." * Now I fail to see why a train passing over a bridge of 30 ft. span, say at the speed of 50 miles an hour, any point of which passes over the bridge in less than half a second, does not produce a "sudden application of a given pull" in the tension members of that bridge. If such a train does produce a "sudden application" then 7,500 lbs. should, for railroad bridges, be the limit for all live load, *without impact*. According to this light, therefore, the formula of Prof. CAIN makes no provision whatever for impact. To be scientifically consistent it appears to me that Prof. CAIN should either lower his lower limit, or raise his upper limit.

It looks to me as if there was too much of the "guess" about formula (10), which Prof. CAIN proposes as a substitute for my formula (*A*), for formula (10) allows a unit stress for steel, for all live load, only 500 lbs. greater than it allows for iron, whilst for all dead load it allows 5,000 lbs. more for steel than for iron, the specified ultimate or temporary strength of the steel being 10,000 lbs. to 20,000 lbs. greater than that for iron. Then again, Prof. CAIN allows for all live load for plates and shapes of steel the same unit stress as for plates and shapes of iron, but for all dead load for plates and shapes of steel he allows a unit stress 3,500 lbs. greater than that for iron; when the specified ultimate or temporary strength of small test pieces of steel is 20,000 lbs. to 30,000 lbs. greater than that for iron. Again, if plates and shapes of iron are as strong as plates and shapes of steel for all live load, why are they not as strong for all dead load. And once more, a formula representing the allowable unit stress for steel should be of the same form as a formula representing the allowable unit stress for iron, since that form depends upon the suddenness of application of the load and the allowance for impact, both of which are independent of the material, and are constant for the same class of structure. Hence the inconsistency between formulæ (1) and (10) which Prof. CAIN acknowledges. None of these inconsistencies exists in formula (*A*).

From WÖHLER's experiments on small prepared test pieces of a certain brand of iron unsuitable for bridges,* WEYRAUCH deduces the working strength of bridge iron, when under tensile stress alone or compression alone, impact disregarded, to be

$$a^{IV} = 30{,}000\left(1 + \frac{1}{2}\theta\right) \qquad \text{I.}$$

where,

$$\theta = \frac{min.\ B}{max.\ B.}$$

Now whilst this may be true, for iron to our standard bridge specifications, for all live load (for then $\theta = 0$ and $a^{IV} = 30{,}000$) we know it is not true for all dead load (for then $\theta = 1$ and $a^{IV} = 45{,}000$) for small test pieces of bridge iron to standard specifications will show instead of 45,000 lbs. an ultimate strength of from 52,000 lbs. to 57,000 lbs. or more. Why then, knowing one limit to be wrong, should we adhere so rigidly to the above formula?

Knowing that the elastic limit or, as I have elsewhere called it, the permanent strength of small test pieces of standard bridge iron is about 30,000 lbs. per sq. in., and that the ultimate strength or, as I have elsewhere called it, the temporary strength, of such pieces to be about 55,000 lbs., per sq. in., why should we not substitute for the above formula, the formula

$$a^{III} = 30{,}000\left(1 + \frac{5}{6}\theta\right) \qquad \text{II.}$$

which gives these limits, and corresponds with the formula of LAUNHARDT originally proposed for flexure.

Without any reason to the contrary I assume that formula II. truly represents the working tensile and compressive strength of small test pieces of standard bridge bar-irons. Now we know from experience that full size members show lower limits than small test pieces, and hence, as the strength of a bridge depends upon the average unit strength of the full size members, instead of the above limits, I adopted in article I. the limits 25,000 lbs. and 50,000 lbs. as they agreed with standard specifications. To represent the working strength of full size members, we have, therefore, instead of II.:

$$a^{II} = 25{,}000\ (1 + \theta) \qquad \text{III.}$$

Subtracting from III. the assumed effect due to impact (varying from 33⅓ per cent. for $\theta = 0$ to zero for $\theta = 1$, as in article I.) which in analogy with Prof. CAIN, I take to be

$$\text{I.} - 8{,}333\tfrac{1}{3}\ (1 - \theta) \qquad \text{IV.}$$

we have for the working stress, impact regarded,

$$a^{I} = 16{,}666\tfrac{2}{3}\ (1 + 2\theta) \qquad \text{V.}$$

and for a factor of safety 3½, the safe working stress

$$a = 5{,}000\ (1 + 2\theta) \qquad \text{VI.}$$

which is formula (*A*) for the case considered. It is thus seen that formula (*A*) may be derived by a process of reasoning similar to that adopted by Prof. CAIN. The process, however, does not appear to me, for two reasons, to be as logical as the process adopted in my articles, for first, it necessitates the use of a factor of safety or "factor of ignorance," and secondly, it does not consider, as my original demonstration does, the various effects in the order of their general nature, viz.: material, workmanship, rust, dead loads, repeated loads, impact loads.

In the above reasoning formula III. is given as representing the working strength of full size members. Dividing by the factor of safety 3½ we have, instead of Prof. CAIN's formula (6) the formula

$$\frac{a^{II}}{3\frac{1}{2}} = 7{,}500\ (1 + \theta) \qquad \text{VII.}$$

Therefore in constructing Table II. the left hand member of formula (8) should also have been changed, the equation becoming

$$\frac{(1 + p_0)}{7{,}500\ (1 + \theta^1)} = \frac{1}{5{,}000\ (1 + 2\theta)} \qquad \text{VIII.}$$

which gives the following table in place of Table II:

TABLE III.

Span in feet.	θ	p_0	p
0	0	.50	.50
—	.1	.34	.38
40	.2	.24	.30
130	.3	.18	.26
220	.4	.13	.22
300	.5	.09	.18
420	.6	.06	.16
540	.7	.04	.15

which agrees as well as Table I. with the very thorough experimental researches of Prof. S. W. ROBINSON on the open web bridges of this country, detailed in the Transactions of the American Society of Civil Engineers for February, 1887.

In the diagram on p. 310, vol. xvii, the lengths of ordinates between lines 7½ to 15, and 5 to 15 represent the amount allowed by formula *A* for impact.

The new method of dimensioning is applicable to the wants of mechanical engineers as well as to the wants of civil engineers. Hence a formula correct for the one should be correct for the other, for conditions approximately the same. There are many machines which would require an allowance of about 33⅓ per cent. for impact for all live load, and in such cases formulæ (*A*) and (*B*) are applicable. The science of mechanical engineering has not yet reached, however, that development and simplicity to enable any such formulæ to be of much practical

* Civil Engineering, 12th Edition, Art. 149.

* Speaking of this same brand of iron, but of another set of experiments, WÖHLER himself says, "The irregularities, which must be attributed to the want of longevity of material, are so great that no certain law can be derived from this set." "The Fatigue of Metals under Repeated Strains," by Prof. SPANGENBURG, p. 17. Van Nostrand.

use to mechanical engineers, further than to enable them to discriminate, more than they have been in the habit of doing, between the relative effects of dead and live (repeating and alternating) loads.

These are all the points in Prof. CAIN'S remarks which appears to call for a reply from me. There are other points of difference in less important details, with respect to some of which, the constants in the column formulæ for example, it may not be out of place to explain that whilst I endeavored to give in my articles practical formulæ, involving as little waste as practicable, I wrote more for the interest of those who can afford to buy the best article, our principal railroad companies for example, than for those who are obliged to do more or less cheese-paring to enable them to successfully compete with their competitors. A. D. OTTEWELL.

EDITOR ENGINEERING NEWS:

In my "Remarks on the New Method of Dimensioning," in your issue of July 23, I desire to make a change in formula (10) giving the unit stress allowable for a *mild steel* tension member (for a reason that will appear later,) by writing for bar steel, in place of (10),

$$b = 9{,}000\ (1 + \tfrac{4}{5}\ \theta) \qquad (10);$$

for plates or shapes the coefficient 9,000 is to be replaced by 8,000. This steel is supposed to have about 60,000 to 70,000 lbs. per sq. in. breaking strength. The formulæ for struts that depend upon this value of b will be correspondingly changed.

I am very well aware that any formula for mild steel, including the effect of indefinite repetition as well as impact, is to some extent guess-work; but it is not so to the extent that might at first be supposed.

To expose the derivation of the above formula, I shall first assume a formula, analogous to LAUNHARDT'S, giving the *safe stress in pounds per square inch*,

$$a = 12{,}000\ (1 + \tfrac{11}{10}\ \theta) \qquad (11),$$

where, say 40 million repetitions of stress, very quickly repeated, is provided for, but the increased stresses due to impact or vibration are not included.

The attentive reader of WEYRAUCH'S "Structures," etc., will bear in mind that WEYRAUCH found the coefficient of θ for hard steel (breaking strength 100,000 lbs.) to be $\frac{6}{7}$ and that $\frac{1}{7}$ was proposed for an 80,000 lb. steel. The coefficient $\frac{11}{10}$ proposed above, should naturally correspond to a very mild steel.

Now if we allow for impact, as explained in the preceding article,

$$I = 3{,}000\ (1 - \theta) \qquad (12),$$

which represents the number of pounds the unit stress must be decreased from the shocks and vibration caused in a bridge truss by the passage of the live load—

On subtracting (12) from (11) we are at once conducted to (10), which does not differ much from formula (10) of the preceding article; for as θ varies from 0 to 1, b in the one case varies from 8,000 to 20,000; and in the other from 9,000 to 20,250. If, however, we estimate the percentage p of the live load that must be added, so that the use of (11) above, will give the same sections as we get by using (10) without any addition to the live load, we shall find that our assumptions (11) and (12) will conduct (by the method exposed on page 37 of the current volume) to the same percentages p (within about .01) as found in Table I for wrought-iron bridges.

I consider this imperative since the ratio of the superadded deflection due to motion of the train to the static deflection caused by the same train, is necessarily the same for a steel as for an iron bridge and we have assumed in both cases the superadded stress for chord members to be directly proportional to the superadded deflection. I had not sufficiently examined this point when I proposed, for unit stresses, in the preceding article, $b = 8{,}000\ (1 + \frac{4}{5}\ \theta)$. To give (very nearly) the same values for p as those found in Table I, we should have to assume the corresponding formula for unit stress without impact to be, $10{,}666\ (1 + \frac{3}{4}\ \theta)$; and the value of impact to be $2{,}666\ (1 - \theta)$. The computation for p is the same as before, and the values differ very little from those of Table I.

The coefficient $\frac{4}{5}$ above corresponds, say to an 85,000 lb. steel, so that the corresponding value of b can be taken to represent a *hard steel*. For such a steel the natural impulse would be to increase the coefficient 8,000, but from some of Mr. BENJAMIN BAKER'S experiments it is doubtful whether we should give any higher unit stresses to hard steel than to mild steel. At any rate the tendency is towards using a very mild steel, and until we know more of the behavior of this metal under stress it is wise not to trust it too far. With regard to the various coefficients of θ that have been found for the LAUNHARDT formula for both steel and iron, it is advisable to incline towards minimum values when there is any choice, or even to take a less value for a bridge member than found (in the case of experiments) for small test pieces; since in the latter the load is more suddenly applied, and there is but a very minute interval between the repetitions; so that the feature of a nearly suddenly applied load, repeated very rapidly, which is included in the LAUNHARDT formula, is more marked for the test pieces than for the bridge members, where the molecules have more time to assume stable positions between the repetitions of stress than in the case of the test pieces.

On this account I prefer the coefficient $\frac{1}{6}$ in the LAUNHARDT formula for iron to a greater value, which may be more correct for test pieces of our high grade iron when subjected to rapid repetition of stress by machinery. The formulæ previously found for direct tension may be used for flexure for simplicity; but it is more correct to take WEYRAUCH'S formulæ for flexure, and subtract the term denoting the influence of impact as above explained, and thus deduce another formula.

Respectfully, WM. CAIN.

The Technical Uses of Asphalte.

In view of the important extent to which asphalte is employed in connection with various industrial applications, the details communicated to the *Deutscher Bergwerksblatt* by Dr. HAUSSERMANN have special interest at the present time. Asphalte (or bitumen) is generally understood to be a black pitchy substance of conchoidal fracture, fusible at a moderately high temperature, and remarkable for its peculiar odor, as well as its combustibility. Passing over the discussion of the external characteristics of asphalte and its chemical properties, it is to a consideration of its technical uses that the author of the paper in question addresses himself, first laying down the distinction between artificial and natural asphalte. The latter is produced by the decomposition of organic substances, partly of antediluvian origin, principally consisting of carburetted hydrogens, more or less complex in their nature, and containing varying quantities of oxygenous or even nitrogenous ingredients. This substance is sold in its natural state, or is obtained by melting certain bituminous rocks at the lowest temperature which will produce the desired effect. It is known according to its origin as Syrian, Dead Sea, Trinidad, Val de Travers, Bechelbronn, etc., asphalte; but two general divisions of natural asphalte are recognised, the Syrian and the American descriptions, the other kinds being of inferior commercial importance. The Syrian asphalte is distinguished from the American substance by its greater brilliancy and by its solubility. It is used for the best descriptions of lacquers and has remarkable adhesive properties.

American asphalte serves for application to iron, to protect it from atmospheric influences by a solid black coating. Where brilliancy is not required, the latter variety can in all cases replace the former. The Val de Travers asphalte is used for paving, mostly in combination with the artificial substance. Asphalte lacquer is produced by dissolving asphalte in turpentine oil or coal tar benzine. Continuous shaking at an ordinary temperature, or careful melting and stirring, form alternative processes, but the latter requires care on account of the danger of fire. It is recommended to dissolve the asphalte and extinguish the fire before adding the essences required, and if the heating has not been too great there is no reason to fear excessive volatilization of the dissolvents.

With a view to reduce the price of the lacquer (while scarcely lowering its quality), it is a common practice to add in melting the asphalte as much as 30 per cent. of ordinary resin. According to the nature of the substances thus employed, various kinds of lacquers are obtainable from the same asphalte. Turpentine oil is, however, the best admixture to prevent any undesirable odor, and to insure rapid drying. Of the various kinds of coal tar benzine, the purified colorless description, with a boiling point of 104° F. to 302° F., comes nearest to turpentine oil in the results obtained. For inferior qualities of lacquer, tar oils with a higher boiling point may be used, but a slow drying and unpleasant smelling composition is produced. These properties will not, however, in all cases be an objection.

The easily flowing distillates obtained from crude petroleum (which are frequently known as benzines) are unsuitable for the manufacture of varnish, as they only partially dissolve the resinous substances present. The so-called artificial asphalte is very extensively used, and is principally distinguished from the natural substance by its dull color and its scarcely perceptible odor. It is a product of the distillation of coal tar. The fluid distillate obtained in the manufacture of coal gas represents about 4 to 7 per cent. of the quantity of coal used, and after about two-thirds of its weight has been removed in the shape of fluid oils by fractional distillation, a residue is left which cools into a firm black substance known as artificial asphalte or black pitch. The consistency of the asphalte varies according to the quantity of oil removed.

One of the most important uses of this asphalte is for fuel in the shape of briquettes, small coal, sawdust, etc., being mixed with it. Asphalte pipes and flooring are also made from it, as well as lamp black of inferior quality. For the manufacture of lacquers artificial asphalte is much less suitable than the natural substance, as the coating obtained is liable to crack and is wanting in brilliancy.—*Industries.*

Emilite—A New Explosive.

It is known that picric acid has been used as an explosive compound or as a basis in various explosive mixtures or compounds and for various other purposes. The said acid was formed in the first instance from coal oils of less than 15 degrees or 20 degrees Cartiar. The same was afterwards, and is generally at the present time, formed from phenol (phenic acid) the latter being procured from coal oils refined in a well-known manner and treated with nitric acid. The process of Mr. P. M. AUDOUIN, of Paris, differs from these in that it does not employ the phenol or picric acid derived therefrom, but consists in treating the residue left after manufacture of said phenol, said residue being a mixture of various compounds of carbon, and having up to the present time been found to be of little or no commercial value. These residual compounds are used in part or entirely, and are in this invention derived from the coal oil by alkaline treatment similar to that used for the extraction of phenol, the latter being obtained as a bye-product in this process. The compounds of carbon so derived and employed in this invention are distinguished by (1) being soluble in alkalines, (2) their boiling points lying between 182 and 120 degrees Centigrade, (3) remaining liquid at ordinary atmospheric temperature. These last two characteristics are sufficient to distinguish the compounds employed from phenol, which solidifies at 40 degrees C. and boils at 180 degrees C.

This group of bodies have been already studied from a general scientific standpoint, but this invention lies in their application and treatment by the action of nitric acid for the production of a solid compound or compounds for use as an explosive or in the manufacture of explosive compounds or mixtures. The compounds of carbon which he employs are obtained from coal oils by treatment with alkali, such as potash, soda, lime, or even ammonia, followed by saturation of such alkali by sulphuric, hydrochloric, carbonic, or other acid. The assemblage of compounds of carbon so obtained is subjected to more or less rectification for the elimination principally of resinous matters and is either thereupon treated with a nitric acid of commerce of suitable strength, or such treatment is applied after a preliminary transformation into sulpho-conjugate products. The apparatus for nitrification is of usual construction, and may consist of stoneware or enamelled or other vessels, and same may be coated inside with a protective layer of compound of alumina or silica resisting acids, and are preferably provided with means for heating and cooling and for agitating or stirring of the contents, and for condensing or utilising the nitrous vapors.—*Engineering and Mining Journal.*

A perforated iron tube filled with a species of refractory clay seems rather an unpromising combination for cooking a meal. Yet these are essential parts of the now much advertised "Earth Fuel." The other very essential component is kerosene oil in which this tube is soaked. It is said that two cents worth of oil will cook a meal.

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D. McN. STAUFFER. A. M. WELLINGTON.

EDITORS.

GEO. H. FROST, - - - BUSINESS MANAGER.

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THE American Society of Civil Engineers, and a good many other such bodies which hold conventions, might learn a lesson in regard to their conduct from the arrangements of the American Association for the Advancement of Science for such meetings, which are admirably complete. On the morning of *each day* of their late convention, a pamphlet of 32 pages was issued to every one of the 700 members in attendance containing; (1) the programme and announcements for the next day or two ahead, corrected up to midnight of the day before; (2) the actions of nominating and other committees (3) the business on hand for the day, and the papers to be read, by each section, which run from A to I; (4) the new members elected the previous day, if any; (5) a complete numbered list of every known member in attendance, running from No. 1 up to the last member who is known to be in attendance up to the hour of going to press, with their hotel or street address.

This latter list is likewise divided according to the days on which each member registered, so that any one can form their own opinion of the probability of their being still on hand at any given date. Moreover, the ribbon badges which are given to each member are all unobtrusively but clearly numbered, so that if the number be read, by referring to the printed list the name of any member in attendance may be determined, or a still hunt started for any desired number.

At the smaller conventions of the engineering societies such arrangements as this are still more easily arranged and carried through, and it should be done, as it would tend powerfully to promote both their technical and social features. Especially in respect to the technical programmes the conventions of the American Society of Civil Engineers are easily capable of great improvement.

Bradstreet's, in comparing the bonded debt and share capital of ninety-eight railroads for four years past, comes to the following conclusions:—That there has been an increase of bonded debt over 1884 to the extent of 15.8 per cent. on 72 roads, as against a stock increase of 8.4 per cent. This is indicative of the changed conditions under which the present development in railroad building is being conducted, the new lines being mainly extensions of established corporations built upon proceeds of bonds. The reorganization of bankrupt roads has also had considerable influence during the past few years, with a marked tendency to decrease the burden of fixed charges by diminishing the amount of bonded debt in the reorganization.

Taken by separate groups the greatest increase in bonded debt is in the southwestern group, corresponding to the great activity of road building in that section; 22 per cent. represents the increase over last year, and 41 per cent. that over 1884. Next comes the granger or northwestern roads with a bond increase of 18 per cent. over 1884 But as there is also a gain in stock to the amount of 15 per cent. in this section, the building of roads by a stock issue has been most prevalent here. The trunk lines remain nearly stationary as to stock and show no striking increase in bonded-debt. The southern group shows an increase proportionate to its development of railroad interests.

When so compared it is seen that the increase in share capital keeps pace very closely with the record of earnings and mileage, while the bonded debt, though increasing at a ratio below the gain in gross earnings as far as the present year compares with 1886, rises when the comparison is extended to three years ago to an increase of 15 per cent., as against nearly the same amount in gross earnings, and but half as much in earnings per mile. The mileage of the roads compared constitute about 30 per cent. of the total railway mileage of the country.

A correspondent in another column makes two suggestions in connection with train-brakes, both of which have much to be said in their favor, but neither of which are new. In respect to statistics there can be no question whatever, that more systematic gathering of statistical records of accidents of all kinds should be made under government authority. Not one of our States, even, is doing the work as systematically as it should be done, nor even fairly well, and for the same reason that the States could not control the railway companies in financial matters they cannot effectually control them in this. Every well managed railway had filed away in its archives somewhere complete returns of every accident to trains, locomotives, brakes, axles, drawbars and the like. It needs but to once prepare a proper blank and back it with power to compel its proper filling out, and most valuable and instructive statistical evidence of what evils were greatest and how to cure them would be obtained. In Germany this is done, and about all we know definitely about axle breakages and several similar matters is through them. In England also the same is done about train brakes, train accidents and a few other records, although the English railway statistics in general are the most imperfect and annoying in their omissions of those of any civilized nation, having only the one great merit that what they do give is correct. In America nothing very systematic is done as to any kind of operating statistics, for which there is certainly one good excuse, that it is vastly more difficult to do here than abroad, both because of the magnitude of our country, the rapid growth of our railway system, and (heretofore) the absence of any national machinery for collecting facts.

The effect is that every railway jealously and not unnaturally keeps its records of such matters to itself, and it must be added, does not even classify its own records systematically This works unfortunately in many ways. The very managers themselves do not know half the facts that occur on their own road, and would not derive much benefit from many of them if they did. Of what use is it to know that a road had 518 broken axles, 7,350 broken wheels, 280 derailments, 125 failures of brakes, and what not? The figures have no meaning. What is wanted is to know whether these are more or less than they ought to be, by comparison with records of other roads and sections. Again, there is immense power in aggregates and averages. The coupler question, for example, would have been settled long since if the appalling totals of broken drawbars, of trains broken in two, of killed and injured brakemen, had been officially collected. But no one can do more than guess that the killed and injured are between 10,000 and 30,000 annually. Similarly we have no doubt that officially collected records of brake failures in service would serve a most useful purpose, by showing what roads had the most of them, and thus enabling the proper remedy to be applied, which for the most part is merely proper vigilance and care.

The other suggestion, we are informed, has been anticipated by at least one great road, the Boston & Albany, which is considering the question of placing a steam brake cylinder as well as an air on its passenger locomotives. There is much to be said for it. The expense is not great; it requires no more brake shoes and it makes it a dead certainty, humanly speaking, that there will always be braking power at hand in an emergency, happen what will. Whether there is enough danger of brakes failing under proper care to make the expense worth while as compared with stricter and more competent supervision is another question, but we think there is much force in what our correspondent hints, that it would at least tend to make clear whether the brakes or something else were really at fault. The English returns, however, must not be relied on too implicitly. Not all their "faults," by any means, are really of any moment, implying a failure in emergencies, and it is alleged with some show of reason that there has been a good deal of gerrymandering in the preparation of the list of faults.

BY the late appointment of Chief Engineer GEORGE W. MELVILLE as the Chief of the Bureau of Steam Engineering, Secretary WHITNEY has made a commendable departure from the traditions of that office, and particularly so in the present stage of our naval history.

Mr. MELVILLE'S predecessor was an able, honest and efficient officer of the United States Navy; but just now the service demands all the work of a younger man. The chief of such a bureau must now have more to recommend him than long and faithful service, and the relative high rank that is usually the result of these years of service. In the very nature of things it must have been some years since the presence of this older officer was required, in the strict line of duty, in the engine or fire-room of a man-of-war, and it is possible that he has never been in this portion of a modern war-ship long enough to fully grasp the details of the situation.

The advance in steam-engineering has of late years been so rapid that it demands a younger man, still full of ambition and personal energy, to keep pace with it; he must intimately know the requirements of the day as well as the latest projects for meeting these requirements; not theoretically only but practically.

And as Mr. MELVILLE is still young, though he has had much experience, and has shown marked ability in the line of his profession, and is possessed of energy and executive ability of an unusual degree, his appointment seems a very good thing.

IN answer to several inquiries we may state that the "Field-Work of Railway Location and Laying Out of Works" announced by Mr. WELLINGTON in his treatise on the "Economic Theory of Railway Location" is not likely to be issued during the present calendar year. The more important parts of it will probably appear first in the columns of this journal.

WE ask the especial attention of our readers to the inquiry for THOMAS C. BEAN in a communication which appears in another column, which is one of great importance to a few individuals, at least.

The Lesson of the Chatsworth Disaster.

All the essential facts of the late great disaster are now known, and given in another column of this issue. All the facts of the case are simple, and there was little really to investigate. It remains only to profit by the accident as much as possible. On the whole it may fairly be said to have been the most disastrous in our history, and with one or two exceptions the most disastrous on record, for although the deaths fell 25 or 30 short of the total at Ashtabula, which heads the list of American disasters, yet when the large number of grave injuries is remembered, it fairly outranks it. That it did not do so completely was due to the fact that this accident was in summer, while Ashtabula was in winter. It is all but certain that fully 75 to 80 per cent. of the lost at Ashtabula were practically burned alive after escaping the fall.

The daily press, as was to be expected, has pounced at once upon the most immediate and obvious cause of the disaster, that the little open culvert was combustible, and vociferously demands that all wooden structures should be done away with, alleging that it was "a crime" that the structure should have been there at all. To this extent they were right, that this particular structure was to some extent an example of the abuse of wood for structures, but in the main the position they took in the matter was utterly absurd, and their allegations in support of it arrant nonsense. This will more clearly appear if we run over in succession the true lessons of the disaster before touching on the false ones. For there are several such lessons which in the order of their importance as compared with the cost of effecting them, may be listed thus:

First: Trains of over 6 or 8 cars should not be made up to be drawn by two engines. A very disproportionate number of disasters have happened to these heavy trains. As many cars as one engine can pull, which is rarely over 10 or 12 cars, may reasonably be permitted. The danger is then but little greater, and in some ways less, than with 2 or 3 cars less, while on the other hand there is a great economy in pulling as many cars as one engine can, before making up another train. But when it comes to putting a second engine in front, and four to six more cars behind, it is a different matter. There is then no appreciable economy, for the entire train crews must be doubled, while the danger is greatly aggravated in many different ways. In this particular case the running of the double train as one was a terrible mistake, and seems to have come chiefly from a wretched kind of vanity to run "a whaling big train," since it was against the advice of the engineman who was killed, and cannot possibly have saved money. Had the 16 cars and 2 engines been divided into two trains, it is to the last degree improbable that there would have been any considerable loss of life to deplore, because the deaths came almost wholly from the TELESCOPING which followed the disaster. The trucks were stripped from the cars as they jumped the gap, just as they were from the front cars at Bussey bridge (where there were 9 cars) but we have only to turn back mentally to that disaster, to see that even cars without trucks do not telescope badly except when there is great pressure behind them, *and* great resistance in front. Now the almost universal rule with breakages of all kinds is, that the engine which causes the breakage itself escapes. In this case the first tender only was wrecked, but the second engine and tender were the true resisting force in front. Had they not been there, even the immense weight of cars behind, could not have caused much telescoping. It would simply have slid the car-bodies further along the track with moderate, and possibly even harmless telescoping. If, however, the rear 7 cars had been in a separate train with another engine, the destructive force from behind would have amounted to little. For each car, after, it was stripped of its trucks, had little surplus energy beyond enough to slide itself along the 150 to 250 that the cars actually moved. Allowing the speed to have been 40 miles per hour, the "vertical head" for which* is 56.80 ft., a friction of one-fourth the weight would stop the car in 227 ft. and a car sliding on the ground without trucks would have more than that.

Therefore, as the tender was not wrecked for some 200 ft. beyond the structure, and as 4 or 5 cars would by that time have been beyond the gap, and so be exerting no pushing force, there would have been only 2 or 3 cars to exert effective pressure, and one less for each 60 ft. the wreck in front slid, whereas in fact there were 9 or 10 cars to exert pressure and the rear 6 very heavy ones. It is to be remembered that no one was injured at the structure itself, nor even a car-body wrecked, and under the conditions outlined it would have been a mechanical impossibility for well built modern cars to have been very disastrously telescoped. There might well have been only one or two lives lost, as has happened time and again in similar accidents.

The primary cause for the awful slaughter, therefore, was in no sense the burning structure, but the unnecessary and gratuitous violation of established operating customs in combining two very heavy passenger trains into one. When the secret of all hearts shall be unveiled, it will probably be found, as we have suggested that this came merely from a foolish but very human ambition to run the biggest train on record. If it can be shown that such accidents, or anything at all approaching it, frequently result from wooden structures *under ordinary and proper operating conditions*, it would constitute a severe indictment of the use of wood, but this cannot be shown, as we shall shortly see.

The second great lesson of the disaster is one which we fear will not be enough taken to heart; that only the grace of God and the time of year prevented the Chatsworth wreck from becoming the most horrible funeral pyre on record. No fires were set by the burning trestle, for the reason that most of the train jumped over it, and went beyond it, the air brakes having stopped the rear sleeper on the edge of the gap, so that they only were threatened with fire, and not harmed. Our very imperfect cuts alone suffice to show the curious way in which the front and rear cars separated. But had there been two separate stoves in each of the seven cars wrecked, or 14 stoves in all, the cars would have been a mass of flames within five to eight minutes, and nothing could have been done by those who escaped except to stand helplessly by and see 200 or 300 more people burned alive who have now escaped with injuries, besides the 75 who were killed outright, but whose numbers or names would never have been known. At Ashtabula, the cars were on fire in several places in two minutes, and a fierce mass of flames in fifteen minutes. At Woodstock fire followed still more quickly. In each of these cases the conditions for quick ignition were not nearly so favorable as at Chatsworth. Had there been fire in those fourteen stoves no human power could have kept the piles of kindling wood which we picture from being on fire in every part within five or six minutes and only the more active among those unhurt would have had much chance of escaping; yet there were hardly more than a handful of the 450 odd people in the wrecked cars who escaped wholly unhurt.

This is so entirely obvious that the occurrence ought to be as awful and as effective a warning as if 300 or 400 people had actually been burned alive, yet it is clear that it will not be. There is probably such an inspection of wooden structures and of weeds along the right-of-way going on just now as was never known before, but we question seriously if any great stimulus has been given to the steam heating question, which ought to be making such progress to-day that no important trains should be be running next winter without steam heating from the locomotive, either in them or ordered for them. Somewhere next winter the holocaust will come. Somewhere there is a road which is doing nothing now, except perhaps to potter around with substitutions for a few wooden structures, because of this disaster, which will burn up a carload or so of passengers and not be able to show that it has taken a single decided step to avoid this danger. We shall feel it a duty and pleasure to make it as unpleasant as possible for the officers of that road by pointing out the facts unsparingly, for there can be no question that it verges closely on that criminal state of mind "regardless of human life," which the law declares to be manslaughter, and punishes by a term of years in state prison. This is so because they have only to open their mind to facts to see that heating by steam is not only the safest but the cheapest way of heating. We are not of those who believe that much larger expenditures can be demanded *merely* to save risks to passengers lives which are already at best small. A great deal of nonsense is talked by the public in that way, applying standards to the railways which it does not think of living up to itself. But when men are so indifferent that they will not open their eyes to see that they can save life and money too, they are deserving of reprobation, and will pretty certainly get it.

The third great lesson of the disaster is as to thorough inspection and clearing up of right of way, especially near wooden structures. This work costs very little, and only needs to be done once or twice a year, and there can be no real excuse for not doing it, although it is very frequently neglected. There seems no longer room for doubt that there has been more than usual and more than reasonable negligence in this respect, considering that the season was one of the dryest ever known, and that to that negligence the burning of the structure was due. An effort had been made to insure safety, but it had not been a well directed and proper effort. Prof. BAKER'S report to this journal seems to establish this fact clearly, by his investigations of the surroundings of this and other structures, and we esteem ourselves fortunate in being able, for the third time this year, to promptly and exclusively present the

* Page 235, Table 118, "Ec. Theory Loc. Railways."

inside facts of such great disasters. There is, of course, a possibility that a spark from the locomotive last over may have set the fire, but in view of all the facts this seems improbable, and as the structure was on a tangent many miles long, there seems but scant excuse for the fact that no watch was kept for anything so easily seen as a wooden structure on fire.

But the fact is undoubted that had the structure not been wooden, there would have been no fire and no accident, and the question then arises: What is the lesson of the disaster in respect to wooden structures? The daily press has answered this question in a very short and summary way, as was to be expected, but we have no hesitation in saying that the true lesson of the disaster in this respect is—that the exception proves the rule—and that wooden structures are as safe as any under such proper and practicable care as is readily secured on well managed roads, or so nearly so that the poorer roads of lighter traffic are entirely justified in continuing their use until their finances warrant thoroughly good and first-class iron and masonry structures. The grounds for this conclusion may be put thus:

1. But for unusual and improper doubling up of trains, the accident would not have been severe.

2. But for unusual and improper negligence in inspection and policing, the accident would not have occurred at all.

3. Had the structure been a little larger, the disaster would not have occurred at all, for it would have given a warning that could not have been mistaken.

4. Had the structure been much smaller, the disaster could not have been so great, for the gap would not have stripped the trucks from the cars.

5, and most important; The records show that only *ordinary* care, skill and watchfulness are needed to avoid such occurrences, and that they are in fact so avoided, so that accidents from wooden structures form an insignificant fraction of the total. Whether from contributing negligence or otherwise, if the records showed that frequent accidents *were resulting* from wooden structures, it would be an irresistible argument against them. It would be nothing to the purpose that in every case more care might save them. More care than the average human being under average discipline gives on an average, cannot be had. The sole question is—Does THAT degree of vigilance suffice for security as completely as with other structures, and the answer is—It does. Therefore it is to be hoped that engineers will not join in the ill-judged howl which the daily press has set up, but look a little before their nose, and keep their judgment cool.

In proof of what we say: CHAS. FRANCIS ADAMS, Jr., published in 1879, a book called "Notes on Railroad Accidents," in which 42 accidents, at home and abroad, from the beginning of the railroad system to date, of a notable and typical character, were described in detail. It was a mere chance collection, made by no rule. Largely it was based of course on exceptional fatality, but the interesting or novel features of an accident had also great influence on the selection.

We cannot attempt to take space to summarize these accidents properly in this issue, but out of the whole list there is only ONE accident resulting in any way from the failure of a trestle or wooden structure, and that a very subordinate accident, described in a foot-note only, in the chapter on bridge accidents, designed to reinforce remarks on the danger of car stoves. The train fell 30 ft. and the cars at once took fire. "Nineteen lives were lost *mostly by burning.*" That, we apprehend, is the most fatal trestle accident on record until this one. It occured on the Buffalo, Corry & Pittsburg road in 1872.

Almost every other possible cause of accident is more numerously represented. *More than a third* of the whole list, for example, were accidents to excursion trains, and very nearly as many were to double-headed trains, although there are only a few trains in 10,000 of either class. Similarly, of all the accidents to trains which have occurred in the United States in the past 13 years only 3½ per cent.* have been due to broken bridges *and* trestles, and of these more than half have been to bridges, which are vastly less numerous. On the other hand, 3.1 per cent.* have come from wash-outs a very large majority of which are from two small openings in masonry culverts. But we shall have to postpone to next week a more careful summary of these facts, and for the preseut leave the subject.

*Econ. Transportation Railways," page 246, Table 99.

The Pay of Young Engineers.

Our correspondent "Division Engineer" who sent us a letter on which we commented in our issue of July 23 and again July 30, expressing a prejudice against the American Society of Civil Engineers, because of the alleged fact that its members showed a tendency to pay less to young men than non-members, writes us another, and far more temperate and reasonable letter of private explanation, which seems to warrant a few words of comment. It does not at all reduce the essential absurdity of his position, that such a Society of 1,000 members, *as a body*, including as it does a very large majority of the more eminent and successful civil engineers of the country, can have a tendency of that kind one way or the other; but passing that allegation, as too absurd for discussion, the general question of what pay young engineers should receive is one which interests them at least deeply, and one on which many of them, we are compelled to believe, have lamentably false notions, standing greatly in the way of their permanent success.

Our correspondent is still young, and we are glad to believe, is a man of some promise. When he is a few years older he will see more clearly that the $90 per month which he objects to, while a man is gaining the experience which is to make him a real engineer, even if accompanied by subordinate charge of a few miles of light work, is not so bad a compensation for one learning a profession which offers so many chances higher up, both within it and just outside of it, This he will always find;—that the more important and successful corporations, and the more prominent and successful engineers, will tend to pay less for the same grade of work than others, and for reasons which should be obvious; that there is a greater pressure of applicants for positions offering so much better future chances, and that as the indirect reward is greater, the cash compensation needed to secure the desired grade of service may be less.

In contravention of our former reference to the pay of young doctors and lawyers our correspondent alleges that "those mines hiring doctors by the month pay not less than $125 and usually $150 per month, and the position is permanent, and the doctor at liberty to accept outside practice." Probably he is, if he can get it, but he has a very poor chance to ever get much. By accepting such engagement he cuts himself off from the best chances of future advancement, whereas the young engineer is just in the way of it, and he is more over *the chief*, with the whole responsibility for all his practice resting upon him, whereas the young engineer in nominal charge of a few miles of work has men in three or four grades above him who direct all his important actions, and revise and supervise all his unimportant ones. Where these conditions do not obtain, doctors far higher up in their profession than the class our correspondent refers to work for vastly less money. For example, the largest number of surgical cases which go to any hospital in this country go to the Chambers St. hospital of this city,—averaging some 70 cases per day. The *chief* of the staff of a dozen or more physicians, a surgeon who has been eight or ten years in active practice after his graduation, receives the "pittance" of—nothing at all,—and he is only able to secure the position at that rate by exceptional proven ability and in the face of the keenest competition, although it is one which demands nearly all his time and is filled by the same man for many years. In this position he rigidly retains to himself the privilege of performing all capital operations, the regular charge for which would be $5000 to $1000. The junior staff of course all work for nothing. Of course also there are indirect advantages. Many private surgical cases are apt to go first to a man in such position, and in a few years his standing will be so established that he can confine himself to such practice, and he has also the privilege of conducting clinical lectures to students, but that does not alter the main fact that men who are so near to complete mastery of every detail of their profession as to secure such a position are glad to get it for nothing, for the mere sake of increasing the experience and establishing the professional standing.

The same is in substance true of architecture, and all other professions. We happen to recall one young architect, a trusted pupil of the late H. H. RICHARDSON, who had been with him many years at less pay, who was glad to go to a distant city to take entire local charge of the erection of an important block of buildings, for the "pittance" of $65 per month. Had he been ass enough to do so, he could probably have gone long since to some small western town and got $100 from some "buck-wheat" architect, or set up for himself and perhaps made $150, but his permanent chances today are vastly better than if he had been guilty of such short-sighted folly.

In the face of these facts such complaints as our correspondent's seem exceedingly silly; so silly that it is difficult to speak of them with patience, but in the hope of doing some good we have endeavored to do so. It is always well for every man to advance himself as fast as possible, pecuniarily and otherwise, if he does not purchase immediate profit at too high a rate; but too many young men seem to fancy that they ought to be able to eat their cake and have it too; that they should not only be vastly better off than workmen under them in position and prospects but in pay as well, and that from the very start. Competition alone will forbid it. So long as there is "room higher up" in engineering—and there will always be—there will always be a larger or smaller crowd of young men seeking an entrance to the road that will take them there. They will seek most the road which seems likely to take them there most surely and quickly, and the cash compensation they will receive will be in approximately inverse ratio to the value of the position in other respects. If, then, there are enough qualified men who think $50 or $90 per month *and* the future possibilities which are open to them a sufficient compensation to fill all positions, why in the name of common sense should any road

pay more? There can be no rational comparison with the pay of laborers and mechanics, because the two employments are not parallel. In the one case the cash payment is all that is gained, and in the other it is not.

Our correspondent says in conclusion: "I would rather work as a laborer at laborer's pay, when moneyless, than to be an engineer for a trifle above that pay." If so, he has an excellent chance to become both a poor engineer and an unsuccessful man. The men *who succeed* in engineering, and all other professions are those who would rather be employed in their own permanent profession for nothing than be earning fair pay in outside employments which do not advance them at all toward their ultimate goal. "All things come to him who knows how to wait," and who devote their thought in the mean time to qualifying themselves to seize upon and profit by chances when they come to them, but no man can serve two masters, and neither can he find any occupation in which the pay is high and the road easy both for young men and old.

We could reinforce this conclusion by endless examples of men who have worked along for years in very important positions offering a fine experience at very low pay, and who have all of a sudden found that both the hour and the man were ready for a quick and great advance. It is hard for young men to realize it, but that is about the only road to permanent success. Those who make a god of their salary account in early life rarely amount to much in later life, at least as engineers, for the reason that they live only in the present, and do not realize the yawning voids of ignorance and inexperience which they have yet to fill. Consequently they do not make enough effort to fill them. Of course it is an undoubted fact that many roads and private employers grind down the pay of all men in their service to an unfair and injudicious amount, either by putting up with an inferior grade of men or by taking advantage of good men's necessities. Such are the chances of war, and young men and old men alike must suffer from it in many individual cases, and are entirely justified in struggling against it by every means in their power. But although individuals suffer thereby, and must ever suffer in every occupation, on a large scale it is not possible. The law of supply and demand, and of "poor pay, poor preach" will regulate it. We have not touched upon that phase of the question at all, and only touch upon it now to say that even in such cases it is the older men who suffer most, because the younger man gets the most important part of his compensation in any case, the experience and training.

The Title and Degree of "C. E."

The following letter has just been received from a distant correspondent, and while his complaint is seemingly just, and at least often heard, it furnishes an opportunity for saying something on this head:

OMAHA, NEB., Aug. 8, 1887.

EDITOR ENGINEERING NEWS:

I desire to protest against the promiscuous use of the degree of C. E. by every man who has learned to turn a transit screw. There are three or more surveyors and engineers in this city who place C. E. after their names, on drawings and in advertising, and who have never obtained the degree, except as they assume it to draw business. One of them, I understand, could no more calculate the size of an iron rod to resist a tension of 10,000 lbs., than he could fly,—or do anything else impossible. It is, to say the very least, most annoying to those of us who spent weary years of study to obtain the degree. M. F. STURGES, C. E.

The truth of the matter is that these two letters, so jealously guarded by a very few engineers, have been so much abused by promiscuous and unwarranted use that they are utterly meaningless and of no real value in establishing professional standing. There is no law to prevent the merest tyro from so decorating his professional shingle, and we can not say but that under the existing system of conferring this degree, he has a plausible right to assume it. Our technical schools are more to blame than individuals for the cheapening of what should be an honored title. And as long as these schools send out beardless graduates with degrees asserting what every member of the faculty knows to be false, is it to be wondered at that gray-headed country surveyors, and others who know less than they, should appropriate it to themselves upon the assumption, that they certainly know as much about engineering "as that boy"?

We believe there are several institutions in this country that follow the practice—which should be universal—of simply certifying that the graduate has spent a term of years in acquiring some knowledge of the theory and practice of some one or more branches of engineering. This is a much more truthful method, and is just as valuable to the graduate for all practical purposes, as the lying degree of "C. E.;" for the mere graduate of an engineering school is not a "Civil Engineer" in the proper acceptance of the term. He has, if he has made good use of his time, simply acquired the art of more rapidly and intelligently advancing in a chosen profession that he has yet to practice. It will take further years of hard work, study, experience in handling men and matter, and the acquirement of knowledge that can not be gleaned from text-books, before he is entitled to take rank even with civil engineers of medium grade. He will do this all the faster, and usually with more satisfactory results by virtue of the teaching of a properly conducted technical school, and he should by all means be so taught. We only object to this school giving the graduate a false start in life by burdening him with a title that he has really yet to earn.

The fact that a medical graduate is an M. D. will not serve as an excuse for the C. E. Without this warrant the doctor could not legitimately practice at all, and thus would be debarred from that experience which can alone make his theory of avail. Properly speaking there are no "assistant doctors," though there are good doctors and very bad ones. But with engineers the case is very different, and there are many steps in the ascent to the highest practice. It requires, for example, but a medium amount of professional knowledge to successfully carry to completion some work which in its inception and design is the result of years of experience and practice. In fact the majority of our oldest and most prominent engineers, men whom the world delights to honor for the deeds they have done, are graduates of no engineering school, save the hard one of experience, and hence have no sheepskin warrant as "C. E's." But they are engineers for all that, and are universally so recognized.

But there is one mark of professional merit that is beyond dispute, and that is, membership of an engineering society that has a high and rigidly maintained standard of admission, so that the applicant must pass a jury of his peers, men who thoroughly know what an engineer is, before he can enter at all. By this tribunal the degree of C. E. is accepted only as a certificate of so much service in summing up his total acquirements. And in the Institution of Civil Engineers, the most powerful engineering society in the world, this term is so little thought of that its members are particularly requested not to use it at all, but to substitute therefor the initials marking their respective grades in the Institution. In our own country the American Society of Civil Engineers is the only similar body having this strict standard of admission, and its certificate of membership is generally recognized as a warrant that its holder has had responsible charge of public works for a term of years and is capable not only of superintending the construction, but of designing such works. In a word it is a degree that has a commercial value to those who require the services of a practicing engineer; while the college degree means little or nothing as issued, either to the holder or to the intelligent employer.

The best advice then that can be given to our correspondent graduate, and others who have a similar complaint to make, is for them to connect themselves with the American Society, in whatever grade their experience may fit them, and to then abandon the adjunct C. E. entirely to those who can have it for the taking anyhow. If the objectionable outsider, "who has no right to the C. E.," should also join the American Society of Civil Engineers, it will be because he has the requisite knowledge and experience to stand, as an engineer, on a level with the graduate, regardless of the fact that he has not had a degree conferred upon him by a college faculty.

The Necessity of Scientific Training for Engineers.

At the first days meeting of the American Association for the Advancement of Science, Mr. ECKLEY B. COXE, who heads the Section devoted to Mechanical and Civil Engineering, read an address with the heading given above. As Mr. COXE has carefully studied this subject rather from the standpoint of an employer than that of an instructor and has practically tested at least some of his views, this address possesses more than usual interest and we give the following abstract:

An occasion like the present when an engineer who is really a business man is called upon to preside over a scientific body, naturally gives him much food for reflection. Having no scientific specialty he can only offer some thoughts that occured to him during the time he has been engaged in active work. Engineering, though the youngest of the professions, is already divided into civil, mining, mechanical and other branches, but there is another kind of sub-division taking place. To some engineers it is a science, to some a profession, to some a business. The words "Engineer" and "Engineering" are derived from the Latin *gigno*— to bring forth, to produce—they involve the idea of progress or evolution, not of creation. This may be called the age of engineering, as it is called the age of progress. The engineer is deeply indebted to those scientists who during the past hundred years have been determining experimentally the data which are indispensable to him and to that other class who have compiled and discussed mathematically the data thus obtained. Many of these men have done their work, which was often appreciated by a select few only, at their own expense and at a great sacrifice to themselves. They are among the noblest and bravest of the soldiers of science. The first practical engineers were developed in the fields or in the workshop. They had generally little preparatory or scientific training, and learned what they could while engaged in the active duties of their profession.

Their great success is thought by some to show the uselessness of scientific training for the engineer. This is a great error. They became what they did in in spite of, not because of their want of scientific training "But there were giants in those days." But the importance of such study is shown by the large number of technical colleges of high reputation in the United States. Engineers of the present day may be divided into three classes: First that of the scientific engineer, including professors, experimenters, compilers and those now in charge of the physical and technical laboratories of the great railroads and industrial establishments. They are really men of science Second—That of consulting engineer. This includes the engineers of railroads, mills, mines, etc., who design and superintend the technical part of the work of such establishments. They answer more nearly to the popular idea of an engineer.

The third class, now becoming a most important one, includes the business engineer, that is, men who will engage to build a bridge or do any other engineering work, furnishing plans, etc., and guaranteeing to accomplish certain required results for a given sum of money, taking all risks. At the present time one of the most important, vigorous and interesting discussion engaging the attention of the engineering world is that of technical education, upon which there is a great divergence of opinion as to the proper relation of theory and practice in the training of the student of engineering. Men of great ability and experience differ widely upon this subject. In law, theology and medicine there is practically a system of study agreed upon, although there is not of course unanimity as to details. But in engineering this is not the case: some consider that the young man who does not go to college, but grows up in an industrial establishment or in a railroad corps will advance better than one who goes to a technical school; others maintain that if a man is well grounded in theory he can pick up his practical knowledge anywhere. These are the extremes, but between them there are a great variety of views, all held by men of ability and experience. If a number of lawyers, doctors and clergymen were to try to lay out a single course for every student who desires to enter either of the three professions, they would find it difficult to agree, and if they did, the course suggested would be bad for every one, though some of those who followed it would gain a good position in their profession on account of their special mental capacity.

May we not be unconsciously endeavoring to frame such a course for students of engineering to follow, which in consequence of the broad field from almost pure science to pure business, now covered by that profession, it is impossible for any student, in the short time at his disposal, to go through except in a most superficial way. May it not be necessary for the student to decide earlier in his college life whether he is going to be a man of science or a man of business and then to devote more time to those studies specially required for the career he intends to embrace. By doing this, may he not only be prevented from wasting much of his valuable time, but also avoid superficial study, which is so bad for a young mind? The highest duty of the engineer is to save waste. If the man who makes two blades of grass grow where one grew before deserves well of mankind, how much more he who prevents the useless labor of sowing seeds that may grow up into worse than useless weeds. I hope you will deem this question worthy of your thought, interested as I know so many of you are in the subject of technical education.

CORRESPONDENCE.

Office of The Knight Engineering Co.,
WABASH, Ind., Aug. 9, 1887.

EDITOR ENGINEERING NEWS:

We had the misfortune to meet with a bridge disaster in our city last evening. A traction engine fell through a bridge into the canal, killing one man and injuring one.

I was called upon to investigate the matter (after the accident, of course) and was horrified to find a pine floor-beam, 6 in. × 12 in., carrying (endeavoring to carry) a panel 12 ft. long and 16 ft. roadway.

This was well rotted off, and, of course, simply crushed down. It was built, I learn, by a "*practical bridge man*" off a big railroad,—and away off.

Could send you full data and photo. but suppose further notice will be of little interest.

Respectfully, F. KNIGHT.

[Our correspondent's statement seems to cover about all that there is much use of knowing about the structure, unless it were the name of the "practical bridge man."—ED. ENG. NEWS.]

The Washington Smash-Up on the B & O.

WASHINGTON, D. C. Aug. 17, 1887.

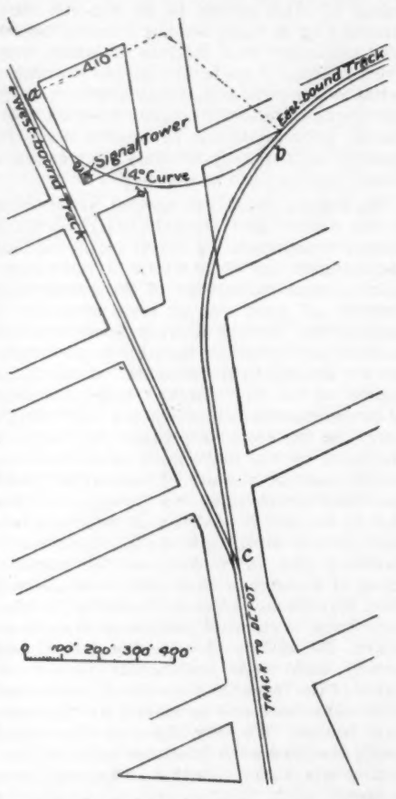
EDITOR ENGINEERING NEWS:

I mail you a copy of the *Evening Star* containing an account of the smash up on the Baltimore & Ohio at this point this morning. To make the account more intelligible I enclose a tracing showing the location of the Y. The Y is a curve of about 410 ft. radius (14° curve.) The track approaching from the west is on a down grade of about 1 per cent. for 1½ miles or more.

All trains from the west pass around the Y from *a* to *b*, and back down the track *b c* to the depot. All trains from the east pass around in the opposite direction, and back down the track *a c*.

The train this morning appears to have been coming in at a high rate of speed, and to have entered the Y all right to pass around from *a* to *b*. There is no sign of any derailment having taken place until the frog at *a* had been passed some 50 ft.

The train was composed of the engine and tender, one each, mail, baggage, and express cars, a smoker, passenger and two sleepers, in the order named. After the wreck the engine lay on its side at the point marked *d*, the tender, mail, baggage, and express cars lay on their sides in an irregular line



Scene of the Washington Collision, B. & O. R. R.

reaching back to the signal tower. The smoker and passenger coach were partly upset, and lodged against the remains of the signal tower at the point marked *c*. Both these cars were standing at right angles to the line *a c*. The two sleepers were on the track about opposite the signal tower. The signal tower, a brick structure two stories in height, was entirely demolished.

A careful examination of the track within half an hour after the accident would seem to indicate that the engine and tender and at least one of the following cars kept the track, but that either the second or third cars jumped the track about opposite the signal tower, dragging with it all the following cars except the sleepers. The express car, the third from the front, appears to have been the one that demolished the signal tower.

The track was in good order, and the only apparent cause for the derailment would seem to be that the brakes having failed to act, the engineer reversed his engine after entering the curve, when the heavy sleepers in the rear crowded forward, forcing the lighter cars in the middle of the train off the track, and these in turn carried the engine and tender over. Yours truly,

FRANK P. DAVIS.

The Black-Balling Question.

MONTGOMERY, Ala., Aug. 9, 1887.

EDITOR ENGINEERING NEWS:

I have read the letter in regard to black-balling, in your issue of Aug. 6 and your article thereon. The writer of the letter asks, is there not an amendment pending to remedy this evil. I do not like the proposition to increase the number of black-balls to 20. I would propose instead that each man voting should be required to sign his name in full, and in case any candidate is black-balled, a record of the vote and the names of the members casting the same, be kept. The five members then who recommend a candidate, can call on the black-ballers for reasons. Indeed, I think the Society should require a man voting against another, especially when he has been approved by the Board of Direction, to give his reasons. No gentleman who objects so seriously to a candidate should hesitate to give his reasons. The truth is, if I wanted to vote against a man, and was afraid to give my reasons for so voting, I should feel as if I were acting the coward by blackballing him when I knew it would not be known who cast the vote. If my objection to a candidate is great enough to make me vote "no," my sense of honor ought to be strong enough to make me willing to state my objections. I am in favor of the votes being made public in such cases, or I should say being accessible to members of the Society, so that it will be known by every member how the others voted.

There should also be some way devised for ridding the society of men who use the black-ball from mere spite. Such men, while they may be good engineers, have not that high sense of honor which I think the members of the Society should strive to maintain. I feel that members should do what they can to suppress this conduct. Expose it and the men who are guilty of it, that is the way to stop it.

W. G. WILLIAMSON.
M. Am. Soc. C. E.

[We are compelled to postpone until next week comment on this letter. We will only say that we agree with our correspondent that the number of black-balls should not be increased, but they should be accompanied by carefully guarded individual responsibility for them, *i.e.*, they should not be absolutely secret but revealed to some one officer at least.—ED. ENG. NEWS.]

Thomas C. Bean.

DES MOINES, IA., Aug. 9, 1887.

EDITOR ENGINEERING NEWS:

There has lately died in Texas, an old man named THOMAS C. BEAN, who came to Texas in 1841. He was very eccentric, and no one ever knew where he came from. He was by occupation a surveyor, and in the days of '41 began to accumulate lands, and was never known to sell. He died worth millions, and if his relatives cannot be found, his vast estate will go to his negroes. His being a surveyor prior to his residence in Texas, may be a clue to his former place of residence. Enclosed please find $2, for which please insert the enclosed, and also make personal mention of this case in your columns. Some old surveyor or civil engineer may remember him, or some dealer in instruments of that date may have known of his former place of residence, and have an entry in their books.

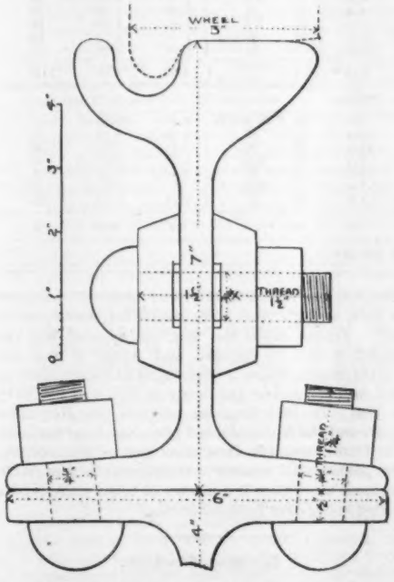
Very respectfully, W. C. MCCORD & CO.

[The notice referred to duly appears in our advertising columns, and the possibility is so important a one to the heirs of Mr. BEAN that we reprint the above letter likewise. ED. ENG. NEWS.]

PERUVIAN RAILROADS.—At the close of 1886,785 miles of railroad were reported in operation in Peru. In 1878 the returns gave 1,560 miles. The difference is due to the war with Chili (1879, '83), which caused great destruction, and ended with the loss of certain lines by cession of the territory containing them to Chili. Two roads of twenty-three miles in all are private, the rest belong to the State. The State, however, manage sonly one short line, the Lima-Ancon; the rest is let out, on various conditions, to private parties. The Peruvian roads consist of ten lines from the coast to the interior. The principal one, 313 miles long, extends from Mollendo on the coast to Puno on Lake Titicaca, and thence northwest to Santa Rosa. Some of its grades are 1 in 25, and at Puno it reaches an altitude of about 15,000 ft. The next in length, the Callao-Lima San Mateo, of eighty-four miles, has grades as steep as the first, and reaches an altitude almost as great. The extensions of both these lines, the former to Cuzco, and the latter to the rich mining regions of Cerro de Pasco, which had been begun, were interrupted by the war with Chili and have not been resumed.

New Form of Street Rail and Track.

The new horse railway track of the West End Co. in Brookline, Mass., is something of an interesting novelty, as it is being laid with the English grooved rail, known as the "Liverpool rail," somewhat modified as to the head, as shown in the accompanying illustrations. In section it is of the I-girder form, similar to that in use on steam roads, but is 7 ins. in height, with ⅜-in. web, and a 6-in. flange at the base. The tread is 3 ins. wide and lies wholly outside the inner line of web. The wheel flanges run in a groove inside the web, a lip being carried out from the web on the inside to form it. The top of rail and lip is flush with the paving block and the depressed groove thus formed, which is sufficient to guide the wheels, is too narrow to allow carriage wheels to become caught in it. The bed for the rails consists of a continuous bar of concrete filled in trenches 18 ins. wide by 8 ins. deep, the concrete extending 9 ins. on each side of the rail center. It is made of the best Portland or hydraulic cement



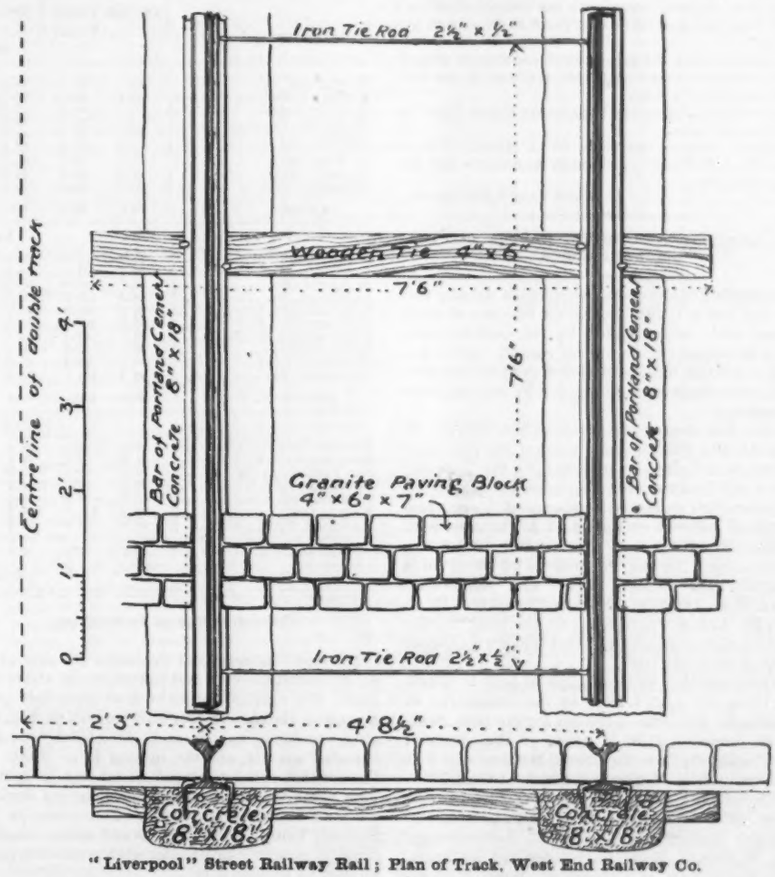
"Liverpool" Street Railway Rail, West End Railway Co.

1 barrel cement to 2 barrels sand, mixed with small hard, broken stone and well rammed. The base of the rails rests upon a full and continuous bearing on the surface of the concrete. Cross-ties of chestnut 4 × 6 ins. and 7½ ft. long are placed across the track every 7½ ft. The rails, which are 30 ft. long, weigh 90 to 100 lbs. per yd., and have splice-bars on each side at the joints, 16 ins. long, containing four ⅝-in. bolts, with round heads and square nuts, the holes on one side being elongated for expansion. The cross-ties are placed near together at the ends of the rails, averaging six to a rail length. Iron tie rods 2½ × ½-in., having ⅝-in. round screwed ends are run across, being provided with two nuts for adjusting the gauge.

Granite paving blocks, 4 ins. thick, 8 ins. long, by 6 ins. deep, are laid on the lower flange of rail so as come flush with its top. For double track the width of paving is to be 18 ft.; single track, 8 ft. 9½ ins The foundation of the paving blocks is a bed of soft mortar covering the flanges of the rails, tops of concrete bars, and ties. A space of ¼ to ⅜-in. is to be allowed between the blocks, and they are laid in mortar so that they do not touch. The whole is to be covered with one inch of sand, kept wet, until thoroughly set, and the street is ready for travel.

The bolt-holes in the T base-plate are 4 in. apart, two sets of bolts going into each end of the rail. The same is the case with the splice bar bolts. The nuts are locked by making them very tight on the bolt.

The West End Co. is becoming an immense institution. Eight miles of track, similar to above, are under contract and the paving blocks are being delivered on Beacon street; 785 gross tons of the imported steel tram rails, or about 5 miles, are to be delivered by Aug. 15, and the company has 3 miles now on hand. The delay in getting the rails has been due to the adoption of a wider tread for the top of the rail than that of the "Liverpool" rail, which required new rolls to be made, to suit car wheels 3 in. wide. The Boston & Albany Railroad are


Iron Tie Rod 2½" x ½"
Wooden Tie 4"x6"
7'6"
7'6"
Centre line of double track
Bar of Portland Cement Concrete 8" x 18"
Bar of Portland Cement Concrete 8" x 18"
Granite Paving Block 4" x 6" x 7"
Iron Tie Rod 2½" x ½"
2'3"
4'8½"
Concrete 8" x 18"
Concrete 8" x 18"

"Liverpool" Street Railway Rail; Plan of Track, West End Railway Co.

filling the section of Beacon street between St. Mary's and St. Paul streets, after which the track will be laid as rapidly as possible. It is expected cars will be run as far as Howard street, Brookline, by Jan. 1. The company expects to lay 10 or 12 miles this year. This is the second railway laid the Liverpool rail in this country; about 4,000 ft. having been laid in Baltimore, where it has given satisfaction.

PERSONAL.

Mr. JAMES DRINKWATER has been appointed Roadmaster of the Smith's Falls & Montreal Short Line.

Mr. THEODORE H. MCKENZIE, M. Am. Soc. C.E., of Southington, Conn., has received the First Congressional District appointment of Inspector of Dams and Reservoirs.

Mr. RUDOLPH HERING has been appointed by Gen. NEWTON, Commissioner of Public Works, to make a thorough examination of, and to report upon, the general sewerage system of the city of New York; the purpose being to recommend improvement and a unification of the work. Mr. HERING is still Chief Engineer of the Chicago Drainage and Water Supply Commission.

SOCIETY PROCEEDINGS.

American Society of Civil Engineers.—The Subscriptions to the Building Fund for the American Society of Civil Engineers, are to date as follows:

Subscription previously reported	$5,235
Thos. F. Rowland	1,000
E. B. Dorsey	50
S. Lindenthal	50
J. F. Sorzano	100
Calvin Tomkins	50
C. L. Strobel	100
Chas. R. Johnson	50
Jos. P. Card	100
Robt. Forsyth	50
P. P. Dickinson (additional subscription contingent on other property being purchased	150
M. M. Tidd	50
G. H. Nettleton	100
John T. Fanning	50
John Lawler	100
Saml. Rockwell	50
C. D. Purdon	10
M. L. Sykes	100
F. E. Bissell	25
Robt. B. Stanton	100
C. B. Brush	100
Jas. Dun	25
C. C. Gilman	100
S. S. Haight	25
Onward Bates	50
Total	$7,810

A committee has been appointed, consisting of T. C. CLARKE, D. J. WHITTEMORE and Jos. M. WILSON, to solicit funds from among members and other persons connected with engineering interests for a larger building for the Society. There are reasonable grounds for the belief that a very large fund may be obtained, sufficient to provide the Society with very handsome and much more commodious quarters, especially if the members themselves continue to show an interest in the matter by substantial contributions.

American Institute.—The Polytechnic Section of the Institute will add this Fall and Winter a course of familiar lectures on scientific subjects. These lectures will be delivered on the first and third Thursday evening in each month, free to those interested. The subject of each Thursday's lecture will appear in the preceding issue of this journal. ROBERT GRIMSHAW, M. E., is President of the Polytechnic Section.

Engineers Club of Kansas City.—In place of the Regular Meeting of August 1, the Club took an excursion to Sibley, July 30th, where the Chicago, Santa Fé & San Francisco Ry. is to cross the Missouri, by invitation of Mr. OCTAVE CHANUTE, Consulting Engineer of the works. There were, including ladies and other invited guests, 52 in the party.

Leaving the Kansas City Union Depot in a special car at 10.45 A. M. by the Wabash road, the party was joined at the junction with the bridge switch by Mr. J. F. WALLACE, Resident Engineer at the bridge, who conducted the visitors to the scene of operations.

The bridge proper will consist of 3 spans of 400 ft. each, one span 250 ft., one span 200 ft. and 2 spans of 175 ft., each, making the entire length of the main structure 2,000 ft. It will be approached on the north side by an iron trestle 900 ft. long and a wooden trestle 3,700 ft. long, making the entire length of the bridge and approaches 6,600 ft.

After examining the plans and materials and the arrangements for prosecuting the work, the party repaired to the private chair car, where an excellent lunch was served. Subsequently a few of the more adventurous members of the party descended into the caissons from which they emerged a few moments later drenched and almost exhausted. They declared that the temperature of the outside atmosphere at 97° was wintry in comparison with the temperature (110°) which they experienced during their short stay in the caissons.

In the afternoon the guests were conducted aboard the contractor's steamboat by Mr. SOOYSMITH and took a short trip on the river.

They returned by special train to the Union Depot at 7.45 in the evening.

A vote of thanks was tendered to Messrs. OCTAVE CHANUTE, J. F. WALLACE, CHARLES SOOYSMITH and the Wabash Ry. Co.

KENNETH ALLEN, Secretary.

The American Association for the Advancement of Science.

The meeting of the above Association during this week and last at Columbia College was one of much interest and was attended by 731 members and guests, according to the official record. Space forbids any but the briefest abstract even of that part of the proceedings most interesting to our engineering readers.

On the first day of the Meeting Mr. ECKLEY B. COXE, the Vice President and head of the Engineering Section, delivered an address upon the Necessity of Scientific Training for Engineers, of which we give quite a full abstract elsewhere. A large number of other papers were presented to the section of Mechanical Science and Engineering during the week's session. Among the authors we note Prof.'s THURSTON, DE VOLSON WOOD and MERRIMAN, Messrs. P. H. DUDLEY, CHARLES E. MONROE, H. T. EDDY, Dr. LEEDS and others. Of the subjects discussed by these gentlemen in their papers we expect to have more to say later,

The next meeting will doubtless be held in Cleveland, Ohio, on Aug. 4, 1888, as the committee so recommend. The officers elected for the next meeting are President J. W. POWELL, of Washington; Vice Presidents, ORMOND STONE, Mathematics and Artronomy; A. A. MICHELSON, Physics; C. E. MUNROE, Chemistry; C. M. WOODWARD, Mechanical Science and Engineering; G. H. COOK, Geology; C. V. RILEY, Biology; C. C. ARBOTT, Anthropology and C. W. SMILEY, Economic Science and Statistics. Mr. F. W. PUTNAM, of Cambridge, Mass., still remains the Permanent Secretary.

PUBLICATIONS RECEIVED.

The Field Practice of Laying Out Circular Curves for Railroads. By JOHN C. TRAUTWINE, C. E., Thirteenth edition, New York. JOHN WILEY & SONS, pp. 192.

This new edition appears to contain no changes of any importance from the former edition, and hence calls for no renewed notice of its undoubted merits.

Baltimore & Ohio Employés Relief Association, Sixth Annual Report of the Relief Features, and Fourth of the Savings and Building Features, Baltimore, Md. S. R. BARR, Secretary.

We have briefly noted elsewhere the main facts contained in this report.

The Maverick National Bank Manual, July 1, 1887. Boston, Mass., pp. 200, many tables.

This manual is certainly a convenient one, containing much statistical data on national and other securities, water-works, banking, railroads, foreign exchange and commerce, agriculture, coal and iron, electrical development, and so on; much of the matter being new and specially compiled for the work. It seems a little out of the proper field of a bank to be publishing such works, but it is certainly a well compiled and useful publication.

Scribners Magazine, for September, will contain a novel story of Japanese life, by E. H. HOUSE; the sixth enstalment of Thackeray's Letters, 1851 52; an article of present especial interest by MONCURE D. CONWAY on "An Unpublished Draft of a National Constitution" by EDMUND RANDOLPH; Prof. GEORGE T. LADD will have an essay on "The Development of the American University" in which he will present a thorough discussion of the subject, and make some valuable suggestions as to the improvement of secondary Education: "The Modern Nile," by EDWARD L. WILSON, will contain many picturesque descriptions of ruins, temples, etc., illustrated from photographs taken by the author.

The Weather of the United States for the Month of July, 1887.

[As respects the elements of most interest to engineers.]
According to special returns from the Chief Signal Officer of the U. S. Army.

STATION.	Temperature. Degrees Fah.				Wind Velocity. Miles per hour.			Precipitation. Rain and melted snow. Inches.		
	Average	Max.	Min.	Range.	Average	Max.	Direction. Max.	Total.	Heaviest in 24 hours.	No. rainy days.
Northern Cities.										
Northfield, Vt.	70.4	91.3	54.0	37.3	7.3	36	N	5.33	1.40	16
Portland, Me.	70.1	95.8	56.7	39.1	13.0	31	S	4.70	1.90	12
New York City.	76.7	94.0	65.8	28.2	6.0	36	W	6.75	2.04	17
Pittsburg, Pa.	80.6	101.1	59.6	41.5	14.7	39	S	9.51	3.85	15
Chicago, Ill.	76.0	99.8	61.0	38.8	9.5	30	W	1.05	0.45	13
Omaha, Neb.	76.3	103.3	55.1	48.2	6.8	25	SW	2.02	0.99	8
St. Paul, Minn.	74.1	93.9	51.3	42.6	3.0	30	W	3.89	1.16	10
Duluth, Minn.	66.6	94.8	52.1	42.7	6 2	34	NE	4.17	1.34	14
Bismarck, Dak.	70.2	95.6	50.3	45.3	5.8	37	N	4.49	1.35	13
Average.	73.4	96.6	56.2	40.4	8.0	32		4.66	1.61	13
Southern Cities.										
Washington City.	80.5	102.8	64.5	38.3	4.7	35	N	3.29	1.16	9
Louisville, Ky.	82.3	101.7	65.1	36.6	5.4	24	W	1.86	1.26	10
St. Louis, Mo.	83.7	100 0	68.0	32.0	6.0	30	SW & S	2.74	1.07	9
Savannah, Ga.	80.4	101.6	69.0	32.6	6.7	36	S	4.72	1.24	11
Leavenworth, Kan.	79.2	101.7	57.3	44.4	5.0	24	NW	1.36	0.60	7
Jacksonville, Fla.	81.0	100.3	69.3	31.0	9.0	42	SW	8.90	2.88	17
Chattanooga, Tenn.	78.1	99.2	64.0	35.2	4.4	35	N	5.30	1.28	19
New Orleans, La.	80.5	95.8	70.0	25.8	4.0	30	NE	7.85	1.95	18
Memphis, Tenn.	80.7	99.0	67.3	31.7	5.0	30	W	3.30	1.22	10
Palestine, Tex.	82.0	101.5	65.5	36.0	7.3	29	N	2.97	1.28	4
Average.	80.8	100.4	66.0	34.4	5.75	30.5		4.23	1.39	11.4
Far Western Cities.										
Helena, Mont.	66.6	91.5	43.5	48.0	7.1	36	NW & SW	0 27	0.10	3
Port Angeles, W. T.	54.3	77.7	37.1	40.6	7.5	31	W	0.56	0.52	3
San Francisco, Cal.	55.2	69.9	49.0	20.9	13.0	35	W	†T	†T	0
Salt Lake City, U.	75.3	97.9	54.1	43.8	5.1	45	SE	1.23	0.74	3
Denver, Col.	69.0	92.1	50.0	42.1	6.8	36	W	2.49	1.05	9
Yuma, Ariz.	92.0	114.0	66.1	47.9	7.6	28	SE	†T	†T	0
Santa Fé, N. M.	66.9	86.8	51.0	35.8	4.5	30	N	2.24	0.63	15
Average.	68.5	90.0	50.1	39.9	7.4	34		0.97	0.43	5

† T = Trace of Rainfall.

Colorado Stone Industries.

The stone industries of Colorado are now giving employment, directly and indirectly, to about 3,000 men. The uptilted strata of sand-stone and quartzite along the eastern foot hills furnish paving, flagging, curbing, rubble and dimension stone of superior quality, and the mining is so cheap that the product can be shipped as far east as Indiana. This stone varies in color from gray to a dark red with all intervening shades. The stone is fine-grained, firm, highly silicious and wears rough instead of smooth like granite, with a resisting power inferior to granite only.

Near Fort Collins about 400 men are employed in the stone quarries and about 10,000 car-loads are shipped annually. Over 10,000 sq. yds. of paving blocks are produced annually. The Union Pacific Co. controls these quarries and the annual value of the output is about $400,000.

On the line of the Denver & Rio Grande R. R. are 16 quarries now sending out over 1,200 cars per month, the largest quarry being at Calumet, in Chaffee county. Other quarries in Fremont, Pueblo, El Paso and Douglas counties are now being worked, for sand-stone, and marble quarries will probably soon be added in Chaffee and Gunnison counties.

The Hotchkiss Gun.

It seems that after all the U. S. Navy Department, in its late order for 100 Hotchkiss guns, was not so slow in recognizing American inventive talent as is generally supposed. The popular impression is that Mr. HOTCHKISS first sought to have his gun adopted by the American Government, and failing in that sold his invention to France, and since then to every other naval power in the world, our own among the last.

But, according to a late sketch of the life of Mr. B. B. HOTCHKISS, it appears that he went to France in 1867 to visit the Exposition, and while there invented and sold to the French Government, within six weeks, a copper cartridge-case to replace the paper ones used by the French army. In 1870 the inventor was in charge of a manufactory of small-arm cartridges, and having had his attention called to the imperfections of the Montigny mitrailleuse, he set about the design of a machine gun for army use. But at the direct request of the French Minister of Marine he made his first gun for the navy. This gun was tested in 1873, and adopted by France in 1874, though none were issued for service until 1877. France made the original request, but the second nation to approve and adopt it was the United States, where it was tested at Sandy Hook in 1877, and ordered by the Army in 1879, and the Navy in 1880. In 1882 England adopted the Hotchkiss 6-pdr. and the Nordenfeldt 3 pdr., but later replaced this latter with the Hotchkiss gun of like calibre. The phenomenal success of the Hotchkiss gun establishment since then is a matter of history, the profits in 1886 being over 7,000,000 francs.

Electric Traction.

The Electric Traction Syndicate, Limited, has recently made some highly successful tests of running horse-cars by electric storage batteries which we find reported in *Engineering*. The trials were made on a rather poor line, 4½ miles long, with some sharp curves and grades, at an average speed of 11½ miles per hour. The car can run in all 25 to 33 miles without recharging.

The car is a small one, and carries 80 cells of 41 lbs. each, or 3,280 lbs. in all. The motor and frame weighed 2340 lbs., or as much as the car. The motor only (of Immisch make) weighed 560 lbs. Its efficiency rises from 70 to 85 per cent at full load, and runs at 1000 revolutions with a current of 160 volts (or 2 volts per cell) and 40 ampéres. The speed is geared down 1 to 10 by two chains and a counter-shaft. The chains have steel links united by cast steel distance pieces. The driving gear includes two switches and a reversing lever. The first switch turns the entire current on and off while the second alters the grouping of the cells from 80 in series to 40 in series, according as much or little power is required. It also puts a resistance in circuit when the car is being started. The delicate question of how the car performed when rapidly stopped and started is not dwelt on.

An "electromotive" weighing 12 tons was also tested, actuated by the same kind of batteries, but it developed no special features. It has 168 cells of 60 lbs. each carrying 70 ampéres. To propel a total load of 20 tons at 8 miles per hour takes a mean of 35 to 40 ampéres, and the electromotive under these conditions will run 25 to 36 miles between charges.

We think there is strong reason to believe that very much better work than this in every way will be done in this country in the near future.

The Iron Bridge Trade in the Future.

A new technical publication under the sounding title of *The Indian, Colonial and Foreign Engineer and Builder and Journal of Public Works* reaches our table, and starts off in Vol. 1, No. 1, p. 4, with an article under the above head so thoroughly British that we copy a good part of it for the amusement of our readers. It is plainly the kind of paper which pleases, or *Engineering* and *The Engineer* would not produce so much of it:

"Generally, up to the present time, however keen has been the competition between rival makers of iron bridges, it has not assumed an international character; England has supplied herself and her colonies, and a similar course has obtained with other nations. During the past three or four years foreign competition in this as in other branches of the iron trade has made itself felt, but to no great extent, and the English and American engineers have remained the most extensive manufacturers of these structures.

Now, however, a new epoch has commenced, the railway system is to spread over China, and in the immediate future large quantities of structural iron work will be required for that vast country. It will be many years before China can be in a position to manufacture her own bridges and machinery, and in the meantime her works must be supplied by foreign countries. In which direction will her attention be directed? The competition here must lie mainly between England and the United States of America.

In noticing the professional status of the two countries, we wish merely to deal with each *upon a basis of fact; bombast and the ignoring of incompetence are not elements of a logical character, nor is it customary for an Englishman to substitute them for argument.*

In a paper recently read before the American Society of Civil Engineers by a Mr. WADDELL he shows that, in his view, if American engineers could agree as to the specifications for their iron bridges the status of American bridge-building would be "so improved as to stand out in greater contrast with the crude and antiquated methods still employed by British engineers." We quote this passage because one word, "antiquated," is so well chosen; it is, from an American engineer, a tribute to the success of British engineers and their methods, for it does not appear, judging from the past and from the present, that even in the distant future many of the American iron bridges will be antiquated; the promptitude with which in so many directions they have fallen and are falling will preserve them from obtaining the epithet of antiquated.

We must not, however, overlook our own errors; we must turn to the one catastrophe of the Tay Bridge—the details have been so sifted by inquiry, they are well known. The Tay Bridge was destroyed by a storm; that storm had not been provided for by the engineer (an eminent North British bridge designer). He admitted his fault during the inquiry, and he died shortly afterwards; his death hastened—or, as some say, caused—by his chagrin at the disgrace into which he had fallen. We fear that if every American engineer whose iron bridge falls down were to die of grief the ranks of American bridge engineers would be considerably thinned.

It may be asked, to what are the uniformly satisfactory results attending the works of British engineers to be attributed? The answer is easily found. *We do not hastily design a bridge on Mr. A's formula or Mr. B's system without due consideration as to their applicability, and, as a matter of fact, the experienced engineer does not tack an individual's name on to any of the ordinary processes of mathematical reasoning; and, furthermore, every particular case of magnitude is carefully studied, so that no point of peculiarity in manufacture or unusual condition of locality can be overlooked.*

We have no wish, nor is it necessary, to extend our remarks. In an ordinary way our British bridge engineers and manufacturers *can well afford to smile* at the precocious self-assertiveness of their American contemporaries, but when a fresh field for labor is opened it behooves them to seek to reap their share of the harvest."

In this connection a little "nonsense rhyme" occurs to us:

> "There was once an old man who said, "How
> Shall I soften the heart of this cow?"
> I will sit on the stile
> *And continue to smile,*
> Which may soften the heart of this cow."

Portland Cement Concrete in Sea Water.

The harbor engineer at Dundee has presented the following report on the latest appearances of failure in the concrete of the graving dock:

I beg respectfully to submit the following additional report on the damage by the chemical action of the sea water on the concrete entrance works of the graving dock:—

The south return wall, measuring 19 ft. long from the outer caisson berth, has softened on the surface from the foundation up to the bottom of the ashlar lining, 3 ft. above low water. The concrete behind four courses of the ashlar masonry, between high and low water, has also softened, loosening the bond of the stones from the body of the concrete.

The softened concrete under water has been removed and the face of the wall has been rebuilt up to low-water level by divers, with Roman cement concrete, in bags, plastered with Roman cement mortar. The ashlar stones which were found to be loose have been taken down, and the concrete rubble backing is now being removed where soft, and rebuilt with Roman cement concrete, faced with ashlar masonry in Roman cement mortar.

The rapidity of the chemical action of the sea water on the south return wall, as compared with the north return wall, is due to the unbalanced pressure of the water on the south return wall when the dock is emptied of water. The pressure on the foundations amounts at low water to 5 lbs. on the square inch of surface, and at high water to 11 lbs. on the square inch.

This causes a current of sea water through the porous structure of concrete of theoretical velocity from 1,500 to 2,250 ft. per minute, which continually washes the decomposed concrete into the dock and brings new particles of concrete and sea water into contact. The water in the caisson chamber, which is open to Albert Basin, counterbalances the pressure on the north return wall, the concrete of which is still quite hard. The concrete inner wall of the caisson chamber is swelled and decomposed, however, admitting leakage through the culverts, the inner invert wall, and the wall under the stairs. Several of the stones forming the caisson meeting face have been loosened and pressed out from their beds by the swelling and softening of the concrete. The rapidity of the chemical action of the sea water on the Portland cement concrete forming the inner wall of the caisson chamber, the culverts, and the north stair and invert wall is also due to the unbalanced pressure of the sea water on the face of the concrete outside the caisson when the dock is emptied of water. The area of concrete surface subject to this pressure on the north side of the entrance is 840 square yards, consisting of the surface of the caisson chamber and the internal surface of the culverts outside the sluices.

When the water is out of the dock this large area is under a mean pressure of 5 lbs. on the sq. in. at high water, which causes a rapid flow of sea water through the pores of the concrete. The area of the surface of the wall affected by chemical action is 610 sq. yds. The area of the interior of the culvert is 616 sq. yds.

To prevent further chemical action on the concrete entrance works, and to insure their stability, it is essential that the whole of the area of surface under pressure of sea water shall be faced with granite or compressed brick, built and pointed with Roman cement mortar. There are indications of the Portland cement concrete forming the arched culverts having softened, and these would require to have granite or brick arches built inside and bonded with the concrete. It is not practicable to ascertain the state of the concrete in the culverts exactly until the outlet is stopped and the culverts dried. I beg respectfully to suggest that the caisson be floated to its outer berth, the outlet of the culverts to Albert Basin stopped, and the entrance works cleared of water to allow in the first place of a fuller investigation of the state of the works being made. The novelty and importance of the investigation make it advisable, in my opinion, to associate with it a consulting engineer of special experience in concrete works of a similar nature.

The harbor Board having adopted Mr. SMITH'S suggestion, it was decided to call in Mr. P. J. MESSENT, engineer to the Tyne Commissioners, in order that he may report on the phenomena.

STATISTICS OF NEW WATER-WORKS CONSTRUCTION.

(Specially Communicated.)

CONTINUED FROM PAGE 101.

Laconia and Lake Village, N. H.—The works were built in 1885, and are owned by the Laconia & Lake Village Water Co.; President, J. C. MOULTON; Treasurer, EDMUND LITTLE; Superintendent, E. L. CHENEY. The works cost $84,919 and the funded debt is $25,000. The present population of the two villages is 8,500. The water is taken from Lake Winnipesaukee and pumped to a reservoir which has a single pipe, storing surplus while pumping. There is a Blake, duplex, compound, condensing engine, with a daily capacity of 1,000,000 galls. There are 12.14 miles of pipe, 1¼-in. to 12-in., 6-in. to 12-in. sheet iron and cement; the services are cement-lined wrought-iron; there are also 74 hydrants and 451 taps. The hydrant rental is $30 each per annum. The average daily consumption is 292,127 galls., or 648 galls. per tap. The receipt for the year ending May 31, 1887, were $7,475.

Newport, Ark.—The works were commenced in October, 1886, and accepted June 22, 1887. They were established by A. H. MCCORMICK, of Parsons, Kan., who owns the franchise. There is an elevated tank, 120 ft. high, with a capacity of 65,000 galls. The price paid for trenching was $1 per rod. The works are operated by the Newport Irrigation & Water Co.; President, A. H. MCCORMICK; Secretary and Superintendent, A. G. HARPER. The present population is about 3,000.

(TO BE CONTINUED.)

NOTE.—The above statistics of new construction are sent in response to special inquiries sent out by us to contractors, superintendents, engineers and others having to do with new works. We have a special blank for this service, and will be pleased to forward one or more on application. We invite co-operation in this special subject.

CONSTRUCTION NEWS.

Water.

Irrigation in Mexico.—It is reported that an American syndicate has a concession from the Mexican government for a large irrigating canal through the Yaqui valley. The work will cost about $1,500,000, and will open up a large area of good land for cultivation.

Washington, D. C.—Major LYDECKER says in his report on the work at the Washington aqueduct that up to July 1, $3,921,701 were expended and $20,000 was available. The amount expended on the new water supply to the end of the last fiscal year was $1,425,131, leaving $240,148 available for the present year. The balance available at the end of June was $493,802. The work on the reservoir was not very satisfactory.

The Topeka Water, Land & Power Co. has been incorporated at Topeka, Kan., by WM. TWEEDALE, J. W. COURIER, H. C. CORWIN, S. K. ROSS, and J. C. DOUGLAS, with a capital stock of $1,000,000. The company will build dams in the Kansas river near Topeka and construct aqueducts for irrigation, mill powers, etc.

The American Well Works, of Aurora, Ill., are the owners of a most effective and ingenious process for boring wells through soft or moderately hard ground. In their method, the well tube is the cutting tool, the end of the tube having teeth of hard steel, and the entire tube is revolved continuously while being pushed down. A stream of water under pressure is at the same time pumped down and washes out between the cutting teeth, cutting away the soil and washing it up alongside the tube. The revolving mechanism is simple, the tube being firmly clamped in the axis of a horizontal revolving geared wheel. In the quicksand and clay of the Gulf coast as much as 500 ft. has been sunk in 10 hours, and 100 ft. in 40 minutes.

Water Companies.—The Santa Barbara & Goleta Water Co. has been incorporated at San Francisco, Cal., to supply the city of Santa Barbara and the town of Goleta, with water from San Jose creek. The directors are: JOHN F. CASSELL, S. ROBERTS, and SAMUEL HART, of San Francisco; W. N. ROBERTS, of Goleta, and GEORGE R. TOMS, of Oakland. The capital stock is $500,000.

The Morgan Water-Works & Ice Co. has been incorporated at Morgan, Tex., with a capital stock of $10,500.

Biddeford, Me.—There is trouble between the Biddeford & Saco Water Co., and the Saco Water Power Co. The former has the exclusive right to lay pipes in the streets, but the latter has already laid pipes in Saco. Treasurers WESCOTT, of Portland, and DEXTER, of Boston, the representatives of the two corporations, will hold a conference in the city shortly for the purpose of coming to some agreement in the matter of water supply in Biddeford. If they cannot agree it is probable that Mr. WESCOTT will file a bill in equity against the Water Power Co.

Montgomery, Ala.—(A CORRECTION) Mr. W. G. WILLIAMSON, City Engineer, writes us that the item on page 101 (which was taken from a southern paper) is incorrect. The city has no contract with Mr. ELLIS to build any system of sewers, and no system has been decided upon. A complete survey of the city will have to be made before any plans can be made, much less adopted.

Pawnee City, Neb.—An estimate of the cost of the new water-works has been made by A. A. RICHARDSON, C. E., of Lincoln, Neb. The system is to include 20,000 ft. of pipe with hydrants, gates, valves, etc.; stand pipe, 100 by 12 ft.; 60 H. P. boiler, pumping engine with a daily capacity of 100,000 galls., two 7-in. tube wells with vertical pumping engine. The engineer's estimate is $26,500 for the works complete, and the city will shortly vote on the issue of bonds for this amount.

Lincoln, Neb.—The contract for the additional water supply has been confirmed. The gang well system will be adopted and a supply of 3,000,000 galls. per day is guaranteed. There will be 80 2-in. driven wells in two parallel rows, 20 ft. apart. A main suction pipe will be connected with each well by a lateral pipe, and the water will be led to a tank, from which it will be pumped by the engine. Mr. Burns has the contract. When completed the works are to be tested to the satisfaction of the city engineer, the water committee and the board of public works.

Cincinnati, O.—The usual complaint as to the quantity, quality and insufficiency of the water supply has been more intense than usual this summer. Superintendent MOORE attributes the insufficiency of the supply to the small capacity of the reservoirs, and the poor quality to the situation of the works. The total pumping capacity is 42,000,000 galls. per day; in hot weather the consumption averages 34,000,000 galls. but on some days the consumption was 44,000,000 galls. The reservoirs contain about 160,000 galls. of water, but when all the water that can be pumped in a day is nearly consumed in that time, very little goes to the reservoirs. In case of a serious fire in hot weather a water famine would result. The scarcity of water in the suburbs is largely due to the practice of sprinkling the lawns. The works are located near manufacturing establishments, and the foul water from these works, as well as the sewage from the outlet near the water-works, is pumped into the pipes. There is no way of filtering the water in the reservoirs as it only remains there 3 days at the utmost. Various suggestions for improvements have been made, the most practicable plan being to transfer the works to the Markley farm, about a mile above Coney Island, where the water of the Ohio river is free from pollution and flows over a clean gravel bed. At this point is a good site for a large storage reservoir. The cost of transferring the works is estimated at $6,000,000, but it could be paid by the revenue from the water works.

New Water Works.—*Maine.* Farmington. The water company will put in a water supply for domestic purposes at once. Address the selectmen for information.——Fort Fairfield. The town is anxious to have a water supply and has voted to pay $600 per annum for 20 years, and give exemption from taxes for 10 years, to any company that will put in a system of water-works.

Rhode Island.—Pawtucket. The dam of the Diamond Hill reservoir, and the buildings, are nearly completed. The entire works will be completed very soon.

Massachusetts.—Mansfield. At the district water meeting on August 9 the vote on the acceptance by the town of the charter granted by the Legislature a year ago, to build water-works for fire and domestic purposes, resulted in 145 in favor against 65 unfavorable, 6 votes more than the necessary two-thirds. There is general satisfaction over the result.——Easthampton. The question of a water supply is again being agitated and Engineer E. C. DAVIS has been investigating the locality in company with the water committee.

New York.—Carthage. A proposition to put in water-works has been made by the Canastota Water Co.——Tarrytown. The vote as to bonding the village for $100,000 for a water supply has resulted in a majority of 19 in favor of the bonds.

Ohio.—Defiance. Water-works are proposed; the wells having run dry in the recent hot weather.

Tennessee.—Bristol. W. W. TAYLOR has made a proposition to build water-works at a cost of $40,000.

Georgia.—Fort Gaines. Water-works are to be established. A supply has been obtained from an artesian well, and a pump will be put in.

Alabama.—Tuskaloosa. The Tuskaloosa Coal, Iron & Land Co. will put in water-works, gas works, and an electric light system.

Florida.—Titusville. The city has voted in favor of water-works, and proposals will be invited shortly.

Michigan.—Imlay City. Water-works are to be established. For information, address W. WALKER.

Illinois.—Olney. The mayor is receiving proposals for a franchise for water-works.——Pittsfield. The city council has voted to issue $20,000 for water-works, and work will be commenced at once.——Spring Valley. The water-works have been commenced. The supply will be drawn from two wells 12 by 8 ft.

Iowa.—Neola. Water-works will be established by S. K. Felton & Co., of Omaha, Neb.

Dakota.—Bismarck. Work is now progressing rapidly on the pipe laying and trenching.

Wisconsin.—Whitewater. Water-works are contemplated. Address the City Clerk, H. S. SALISBURY, for information.

Kansas.—Ness City. A system of water-works is to be established.——Greenleaf. Water-works are contemplated.—— Stafford. Work will be commenced shortly on the new works.

Nebraska.—Riverton. The vote on the issue of water bonds, resulted in an almost unanimous favorable vote.——Pawnee City. The ordinance for the issue of bonds for $28,500 for water-works, was passed August 9, and the issue will be voted on by the citizens September 12. A. A. RICHARDSON, C. E., of Lincoln, Neb., is preparing the plans.

Colorado.—Grand Junction. The question of issuing bonds for water-works will be voted on September 6, and there is a strong feeling in favor of the scheme. Contractors should address J. P. SWENEY, Mayor.

Canada.—Woodstock, Ont. A water supply will be obtained from the Thornton springs, and pumped to a reservoir.——Kingston, Ont. The ordinance appropriating $120,000 for the purchase of the water-works has been passed.

Accident to a Reservoir.—*East St. Louis, Ill.*—A disastrous and unaccountable accident happened to the reservoir of the East St. Louis Water-Works, East St. Louis, Ill., on the night of Aug. 10. The reservoir which was built last year, is 440 ft. long, 160 ft. wide and 16 ft. deep, and consists of two basins, a wall 160 ft. long dividing them equally. This dividing wall was 7 ft. thick at the bottom and 2½ ft. at the top, and was as high as the outside walls that surround the reservoir, 16 ft. On Wednesday evening the engineer went up from the pump house to the reservoir and found everything all right, but when he went there on the morning of the 11th, he found that the entire wall across the center of the reservoir had given way and fallen into the east basin. Mr. HORNER, the Superintendent, made an investigation, but was unable to account for the collapse of the wall. The reservoir, he said, had been put up in the best style, and no expense had been spared upon it, and if the division wall was imperfect or weak he could not understand why it should have given way on that night, for in the west basin there was 12 ft. of water, and in the east basin 11 ft., so that the pressure could not have been great against it. At many times one basin had been nearly filled, while in the other there had been scarcely any water at all, and if the wall was defective or weak it should have given way under such strong pressure against it. Only recently, he said, the eastern basin had been empty, for the purpose of cleaning it, while the other was filled, and during that period he had a large force of men at work in the basin. If the wall was weak it should have given way at that time, but if it had every man in it would have lost his life. He himself superintended the work, standing much of the time on the now demolished wall. He had critically examined the wall, and found it perfect throughout. Messrs. Niemes & Reimann, who constructed the reservoir, are firmly of the opinion that it was not the pressure of the water that carried down the wall, for the pressure could not have been great with a difference of only a foot of water in the two basins, and especially, they say, when it is taken into consideration that it had withstood the immense pressure, frequently, when one basin was full and the other empty. They declare that the wall was constructed of the best material, put up in the best manner possible, and they believe that some other cause than water pressure occasioned the catastrophe. There is an impression that an attempt had been made to destroy the works by dynamite, but though the company will sustain considerable expense for repairs, the works are intact, except the loss of the dividing wall, there being now only one basin instead of two. The loss is estimated at $10,000.

166 cords. J. A. LATHAM, C. E., 45 Westminster street, Providence, R. I. August 25.

Iron Bridge and Substructure.—Across Pawtuxet river at Cranston, R. I. Iron bridge, span 140 ft., roadway 20 ft., capacity 100 pounds per sq. ft. Also two abutments, 202 cords of stone each, in cement. J. A. LATHAM, C. E., (*as above*). August 25.

Lighthouse.—Repairing lighthouse piers and erecting towers at Point Claire and Dorval, Jacques Cartier county, P. Q. WM. SMITH, Deputy Minister of Marine, Department of Marine, Ottawa, Canada. August 25.

Railroad.—Constructing first 10 miles from Lynchburg, Va. P. J. OTEY, President, Lynchburg & Durham R. R. Co., Lynchburg, Va. August 25.

Sewer Work.—Trenching and back filling, 100,000 ft. Flush tank, brick reservoir chamber, 30 × 10 ft., and discharge chamber 4 × 3 ft.; cast iron rims and covers. Circular cast-iron rims and covers, 600. M. D. HAMILTON, President, Board of Trustees, San Diego, Cal. Aug. 25.

City Work.—Grading, curbing, gutters, culverts, retaining walls, etc. August 25. Sewers and drains, August 31. Street improvement, sewers and drains, asphalt paving, September 1 and 2. THOMAS G. SMITH, President, Board of Public Affairs, Cincinnati, O.

Water Pipe Box & Fender.—Rebuilding pipe box and fender at Chelsea bridge north. Plans and specifications at the office of the City Engineer. H. T. ROCKWELL, Chairman, Water Board. Boston, Mass. August 27.

Removing Ledge.—Babson's ledge, Gloucester harbor, Mass.: to 14 ft. at low water. Lieut. Col. G. L. GILLESPIE, U. S. Engineer Office, Post Office Building, Boston, Mass. August 30.

Pier.—Wooden pier at foot of W. 37th street, North river. THE DOCKS COMMISSIONERS, Pier A. North river, New York City, August 30.

Bridges.—Two iron bridges, 100 and 160 ft. span. W. G. GAMMON, Chairman, Commissioners of Roads and Revenue, Rome, Ga. September 1.

Pipe and Specials.—Cast-iron water pipe, 20 tons of 6-in., 5 tons of 4-in.; 10,000 pounds of special castings. THE BOARD OF WATER COMMISSIONERS, Yonkers, N. Y. September 1.

Gas Lighting.—HUGH J. TOLAND, Superintendent of Lamps, City Hall, Boston, Mass. September 1.

Lighthouse.—Ironwork for Harbor Island lighthouse, North Carolina. Capt. J. C. MALLERY, U. S. Lighthouse Engineer (5th and 6th Districts), Baltimore, Md. September 3.

Dredging.—In Cape Fear river. Capt. W. H. BIXBY, U. S. Engineer Office, Wilmington, N. C. September 5.

Paving, Sewer and Street Railroad.—On Central Viaduct; grading, Medina block paving, 750 ft. of double track street railroad, and drainage sewer, WALTER P. RICE, City Engineer, Cleveland, O. September 10.

Bridges and Road Work.—Culvert and road grading; masonry, bridge and fill; iron superstructure, abutments and fill; iron superstructure; iron superstructure and masonry. FRED RAINE, County Auditor, Cincinnati, O. September 10.

Bridge Piers.—The following proposals for masonry piers for the new Harvard bridge were opened August 15, by the Board of Commissioners of Harvard Bridge, Boston, Mass.:

Bidders.	Dredging, 5,000 cu. yds.	Spruce Piles, 2,240.	Curbing, 3,800 lin. ft.	Portland Concrete, 2,676 cu. yds.	Pier Masonry, 3,710 cu. yds.	Coping Masonry, 994 cu. yds.	Total.
John Shields & John Carroll, Boston	0.40	4.50	7.25	5.00	16.00	20.00	122,820.00
Boynton Bros., Boston	0.33	2.50	5.00	8.50	17.76	21.00	125,838.60
Mt. Waldo Granite Works, Frankfort, Me	0.30	3.87	6.00	7.25	19.83	19.00	135,851.60
Joseph H. White & Co, Boston	0.30	2.50	5.00	8.50	22.27	30.25	147,267.70
C. H. Edwards & G. H. Cavanagh, Boston	0.30	3.93	6.48	8.50	21.70	21.70	149,500.00
D. Connery & Co., Boston	0.97	4.75	5.55	8.81	23.00	33.00	162,724.70
Turnbull, Cheney, Hayes & Co., Boston	0.35	5.00	7.00	9.75	26.00	38.00	176,714.50
Wm. H. Ward, Lowell	0.50	8.00	14.00	9.00	27.00	30.00	213,540.00

The contract was awarded to John Shields, of Toronto, and John Carroll, of St. Catherines, Canada.

Proposals Open.

Electric Lighting.—THE COMMISSIONER OF PUBLIC WORKS, 31 Chambers street, New York City. August 22.

Sewers.—Pipe sewers, 12 and 15 ins.; brick sewer, 24×36 ins. HENRY FLAD, President, Board of Public Improvements, St. Louis, Mo. August 22.

Street Work and Sewers.—T. J. NEVILLE, Clerk, Executive Board, Rochester, N. Y. August 23.

Bridge Piers.—Completing main piers of Grand avenue bridge, including necessary iron work. HENRY FLAD, President, Board of Public Improvements, St. Louis, Mo. August 24.

Street Work.—Grading, paving and curbing. A. E. SMYRE, City Commissioner, Baltimore, Md. August 24.

Sewers.—PERCIVAL W. ST. GEORGE, City Surveyor, Montreal, Canada. August 24.

Iron Bridge and Substructure.—At Arkwright, R. I. Iron bridge, span 127 ft., roadway 18 ft., capacity 100 pounds per ft. Also abutments and wing-walls, about

Dredge Hull.—The following proposals have been received by Major AMOS STICKNEY, U. S. Engineer Office, Louisville, Ky.: Howard F. Cook, price each half, $1,680.50, total cost, $3,361; J. A. Porter & Samuel C. McClintock, $1,415, $2,830; M. Cox, $995, $1,990.

Water Tank.—The following proposals for the erection of an iron water tank, with concrete foundation, at Jefferson Barracks, Mo., were opened Aug. 12 by C. W. FOSTER, Depot Quartermaster, U. S. A., St. Louis, Mo.: J. & F. Wangler, tank, $5,164; foundations, $7.15 per cu. yd.; J. F. Deppe & Bro., $2,750, $360; Shickle, Harrison & Howard Iron Co., $2,984, without foundation.

Pipe and Specials.—The following proposal was opened Aug. 15, by HENRY FLAD, President, Board of Public Improvements, St. Louis, Mo.: Shickle, Harrison & Howard Iron Co., 20 tons of 3 and 4-in. water pipe $39 per ton, $1,170; 50 tons of special castings, $55 per ton $2,750.

Car Shops.—The Louisville & Nashville R. R. Co. will locate the consolidated car shops at Decatur, Ala. The buildings are to be of brick and iron. The shops and yard will cover 57 acres.

Dam.—The American Optical Co., Southbridge, Mass., is building new mills and dam at Lonsdale. The contractors for the dam are Wellington & Kimball. A. C. MOORE, of Sturbridge, Mass., prepared the plans and has charge of the work.

Artesian Well.—The following proposals have been received by G. H. COLE, City Clerk, Toledo, O.: F. Hale, Toledo; rock, $3 per ft.; earth, $1.25 per ft. W. Einsberger, Toledo; rock and earth, $1.95 per ft. each.

Bulkhead Repairs.—The following proposals were received Aug. 12, by the Kings County Board of Supervisors, Brooklyn, N.Y.: James Howard, Brooklyn, $3,300; John D. Walsh, Brooklyn, $3,847. The contract was awarded to James Howard.

Masonry.—The following proposals for the masonry for the north section of the new court house have been received by the commissioners, Boston, Mass.: W. & H. A. Root, $148,989.14; Woodbury & Leighton, $145,257; Augustus Lothrop, $142,257; Sampson, Clark & Co., $139,999.

Court House and Jail.—The following proposals have been received by the Board of County Commissioners, Aitkin, Minn.: T. P. Healey, Minneapolis, Minn., $14,850; Gregg & Griswold, Minneapolis, Minn., $13,670; W. T. Chadbourn, Elk River, Minn., $13,475; Alex. Grant, Big Lake, Minn., $13,200.

Pipe, Hydrants, Etc.—The Township Committee, Kearny, N. J., has awarded contracts as follows for material for the new water-works: mains, M. J. Drummond, New York, $52,525.40; hydrants and gates, Galvin Brass & Iron Works, Detroit, Mich.; pipe laying, Wade & Eagan, $14,258.57, and $900 additional for building the meter vaults. Work will be commenced very shortly.

The New War Ships.—The contracts have been awarded as follows by the Navy Department: Cruiser No 1, the *Newark*, is awarded to Cramp & Sons for $1,248,000, according to the department's plans for the hull and the contractor's plans for machinery: cruiser No 4 to Cramp & Sons, contractor's plans, for 1,350,000: cruiser No. 5, to the Union Iron Works, of San Francisco, department's plans for hull and machinery, for $1,428,000, and gunboats Nos. 3 and 4 to N. F. Palmer, Jr., & Co., of New-York (Roach's assignees,) at $490,000 each.

Crib Superstructure.—The following proposals were opened Aug. 15 by Major S. M. MANSFIELD, U. S. Lighthouse Engineer, Detroit, Mich., for rebuilding the superstructure of crib work surrounding the keeper's dwelling at Milwaukee, Wis.: Christopher H. Starke, Milwaukee; pine timber, $18 per M.; pine plank, $18 per M.; drift bolts, 4 cts. per pound; spikes, 5 cts. per pound; stone ballast, $7.25 per cord; framing, $18 per M.; total, $7,009.31. William T. Casgrain, Milwaukee; $17.90, $17,90, 3 cts., 4 cts., $7.90, $16, $6,668.12. Hiero B. Kerr & Co., Chicago, $16, $14, 4 cts., 5 cts., $8, $15, $6,322.17.

Railroad Contracts.—*Mobile & Dauphin Island R. R*, Wm. W. Ansley & Co., of Birmingham, Ala., have the contract for laying the track on the whole length of the line from Mobile to Cedar Point. Also another contract for grading 5 miles of the line from Fowl River station. The road will be open to Cedar Point by December.

Georgia Southern & Florida R. R.—W. J. Winner, of Valdosta, Ga., has the contract for grading 16 miles from Valdosta.

Tuskaloosa Northern R. R.—The contract for grading the first 10 miles of the road has been awarded to Robert Squires & Co., of Birmingham, Ala., and Cincinnati, O.

Mexican National Ry.—At the offices at Laredo, Tex., 12 bids for the construction of the line from Saltillo to San Luis Potosi were opened August 10 by President RAOUL. The lowest bids were from Messrs. Hampson and Thornton, the former of El Paso and the latter of Kansas City, and the contracts were awarded to them.

Street Work.—*Brooklyn, N. Y.*—The following proposals for grading and cobblestone paving on Dean street were opened by the Commissioner of City Works, Aug. 15: Harris & McGuire, $4.80 per lin. ft.; James F. Gillen $4.65 per lin. ft.; Thomas McDonald, $3.87 per lin ft.; John Hickey, $3.50 per lin. ft.

Wilmington, Del.—The following contracts have been awarded by the Board of Directors of the Street & Sewer Department; paving and grading gutters, Davis & Brother, 18 and 22 cts. per sq. yd.; curbing, Davis & Brother, 9 and 11 cts. per ft.; grading and paving crossings, Davis & Brother, 36 cts. per sq. yd.; and Davis & Simmons, 30 cts per sq. yd.; iron castings, Harlan & Hollingsworth Co., 2¼ cts per pound; sand, Combs Coal & Lumber Co., $1.40 per load of 25 bushels; cement, Chas. Warner Co.; lime, Combs Coal & Lumber Co., 25 cts per bushel.

Toronto, Canada.—The Committee on works has recommended the following work: Cedar block and cobblestone pavements, stone, flag sidewalks, Stewart's patent granolithic sidewalk and granolithic sidewalks with stone curb.

Sewers.—*Kansas City, Mo.*—The mapping out o sewer district 43 and the construction of a sewer therein is the most important public improvement that will be undertaken this year by the city engineer's department. The cost is estimated at $125,000, and Assistant City Engineer MASON is hurrying along with the preparations. The plans are now being made. The district includes 160 acres and the sewer is much needed. The ordinance for the work will be passed shortly and the construction be pushed rapidly.

Omaha, Neb.—Contracts have been awarded by the Board of Public Works to De Lancey, Murphy & Co., for storm sewer, district 26, and Hugh Murphy, district 27. The contract prices were as follows; district No. 56: 24, 21, 18, 15 and 8-in. sewer pipe, $2.74, $2.30, $1.57, $1.29 and 97 cts. per ft.; manholes and catch basins, $4, each; grading, 30 cts. per cu. yd.; gravel, $2.75 per cu. yd.; concrete, $6 per cu. yd.; brick masonry, $18; rubble masonry, $9; oak and pine lumber, $45 and $25 per 1000 ft. B. M.; piling, 70 cts.; cast-iron, 4 cts. per pound; ¾-in. lead pipe, 62 cts.; flush tanks, $5.50 per vertical foot, District No. 57, 18, 15 and 8-in. sewer pipe, $1.60, $1.35 and 85 cts.; manholes, $3.50; catch basins, $5; grading, 30 cts.; gravel, $3; concrete, $6; brick and rubble masonry, $18 each: oak and pine lumber, $40 and $30; piling, 80 cts.; cast-iron, 4 cts.; ¾-in. lead pipe, 60 cts.; flush tank, $5 per vertical foot.

Little Rock, Ark.—The contract for 7,680 ft. of sewer in district No. 12 has been awarded to E. W. Weigel [& Co., at the following prices: excavating and back filling, 20 cts. per lin. ft.; pipe laying, 12 cts. per lin. ft.; manholes, $13 each; flush tanks, $40 each. The contract for pipe, etc., was awarded to the Falls City Sewer Pipe & Terra Cotta Works, Louisville, Ky. The sewer is for the Waring system.

Toronto, Canada.—The Committee on Works has awarded contracts as follows; A. W. Godson, $8,997; John Farley, $765.83, $720. Wm. Jones, $1,201, $1,249. George Montgomery, $995, $450, $435, $930, $992. The committee recommends the construction of a number of other sewers in several streets.

Bridge Contracts.—*Boston, Mass.*—The only proposals received August 12 by the Park Commissioners for a bridge on Agassiz road, at the Back Bay Improvement, was from THOMAS A. ROWE, of Boston, $34,814.

Avondale, N. J.—The following proposals were opened August 10, by the Joint Committee of Essex and Bergen counties, for a bridge across the Passaic river at Avondale: Substructure: A. E. Sanford, $11,495; J. W. Stagg, $13,334, modified plans, $11,588 and $9,740. Superstructure; Riverside Iron Works, $16,167, with wooden stringers, $14,416; Bartley Iron Co., $14,080; Passaic Rolling Mill Co., $13,000; King Iron Bridge & Manufacturing Co., iron, $11,995, with wooden stringers $10,795. The contract for the substructure was awarded to A. E. Sanford, at $11,495; for superstructure to the King Iron Bridge & Manufacturing Co., at $10,795 J. OWEN, of Newark, N. J., was the engineer.

Yuba City Cal.—The following proposals have been received by the County Clerk of Sutter county for two wooden bridges, 1,300 ft. and 400 ft. span; B. C. McMahon & Co., $7,275, $2,475; Main & Hudson, $7,750, no bid; American Bridge & Building Co., $7,683, $2,540; San Francisco Bridge Co., $7,787, $2,750; Pacific Bridge Co., $9,100, $2,740; California Bridge Co., $7,774, $2,788; W. F. Peck, $8,427.50, no bid. The bents are of 12 × 12 ins. posts and caps; the stringers are 4 × 14 ins.; planking, 3 × 4 ins.; fence posts, 4 × 6 ins.; two fence rails 2 × 10 ins. and 1 × 6 ins.; hand rail, 4 × 6 ins.

Washington, D. C.—The following proposals for a highway bridge across the Potomac river were opened August 16 by Lieut. Col. PETER C. HAINS, U. S. Engineer Office: Smith Bridge Co., Toledo, O., $150,000; Mount Vernon Bridge Co., Mount Vernon, O., $148,000, or $127,000 if iron substructure is accepted; Pittsburg Bridge Co., Pittsburg, Pa., $123,000; Groton Bridge Manufacturing Co., Groton, N. Y., $105,000.

London, O.—Proposals have been received by the Joint Commissioners of Franklin and Madison counties for a bridge 175 ft. long with a 16 ft. roadway over Big Darby creek at High Ford, on the county line. The bids for sandstone abutments ranged from $6 75 to $7.50 per perch, and the contract was awarded to C. D. Schwartz, of Columbus, O., at $6.75 per perch for material and masonry and 40 cts. per cu. yd. for excavation above and below water. The following were the bids for the superstructure, the prices being per lin. ft. and the first being for wood: Pugh & Son, Bellefontaine, O. $19; King Iron Bridge & Manufacturing Co., Cleveland, O., $36.50; Columbia Bridge Co., Dayton, O., $37 33; Massillon Bridge Co., Massillon, O., $37.40; Smith Bridge Co., Toledo, O., $37.50; H. P. Hepburn, Cleveland, O., $37.60; Wrought Iron Bridge Co., Canton, O., $38; Columbus Bridge Co., Columbus, O., $38.10; Champion Bridge Co., Wilmington, O., $38.25; Penn Bridge Co., Beaver Falls, Pa., $38.74; Pittsburg Bridge Co., Pittsburg, Pa., $38.78; Lomas Forge & Bridge Works, Cincinnati, O., $39; Mount Vernon Bridge Co., Mount Vernon, O., $39.62; Indiana Bridge Co., Muncie, Ind., $39.90; Motherwell Iron & Steel Co., Logan, O., $40.

Rip-Rap.—The following proposals for 750 cu. yds. of rip-rap at Back River light station, Chesapeake bay, Va., and Mathias Point Shoal light station, Potomac river, Va., were opened August 13 by Capt. J. C. MALLERY, U. S. Lighthouse Engineer (5th District), Baltimore, Md.: McClenahan Bros., Port Deposit, Md., Back river, $7 per cu. yd.; Mathias point, $5 per cu. yd. Milo W. Locke, Wilmington, Del.; $5.50 and $3.5 cu. yd.

Car Works.—The following proposals have been received by the Burton Stock Car Co., Wichita, Kan., for the erection complete of the several brick shops, iron roof trusses and wooden buildings for the new works: Thos. H. O'Neil, $89,900; Burton & Berger, $91,019; G. M. West & Co., $99,908; W. H. Sternberg, $99,929; T. V. Major & Co., $108,000; Frank Werner, $109,000; Wright & Bassett, $115,800; W. T. Whitmore, $116,710; C. V. Bissell, $119,631; Russell & Bros., $80,637 (withdrawn). The contract was awarded August 12 to T. H. O'Neil, of Wichita. E. F. PERKINS is General Manager of the company.

Submarine Pipe Laying.—Messrs. Thacher & Breymann, Sheboygan, Wis., have completed their work at Racine. The work consisted in laying three river crossings, 8-in., 20-in. and 24-in. pipe, all laid in trenches 20 ft. below the surface of the water: also one 24-in. influent pipe, 7,275 ft. long from the shore, in Lake Michigan; this was laid in a trench 10 ft. deep out to 40 ft. of water, making the pipe at the outer end 50 ft. deep. The pipe was the ordinary bell and spigot joint kind, laid in sections of 72 ft. each, that is, every sixth joint was made under water. A submerged crib was placed at the inlet, the top being 30 ft. below the surface of the water. The same firm has commenced work on a similar, but smaller contract at Sheboygan. This consists of laying 2,000 ft. of 20-in. influent pipe in Lake Michigan, the pipe being in a trench 4 ft. deep out to 30 ft. of water; also two 12-in. river crossings in trenches, 20 ft. below the surface of the water.

Reservoirs.—At Nashville, Tenn., the following proposals were opened August 9 by the Board of Public Works for the construction of the new reservoir: W. B. Beach & Co., $603,887; Williams & Tolmie, Nashville $558,180; Owen Patterson, Baltimore, Md., $474,750; Gilbert Peterson, Washington, D. C. $438,910; Smith, Leonard & Mumford, Niagara Falls, N. Y., $435,984; Meyer & Alexander, Nashville, $429,930; Huston & Freeman, Glendale, O., $400,955; Southern Construction & Quarry Co., Nashville, $359,272; Hicks, Holmes & Co., Indianapolis, Ind., $359,022.50; Harold, McDonald & Co., Pittsburg, $351,302.60; R. P. McClure, St. Louis, $337,905; Smith, Waters & Co., Baltimore, $336,712; Whitsit & Adams, Indianapolis, $330,921. The contract was awarded to Whitsit & Adams, who guarantee to complete the work in 20 or 24 months. The appropriation for the work was $434,000. The reservoir will be of masonry and will have a capacity of 50,000,000 galls.

At Providence, R. I., the contract for the Fruit Hill reservoir has been awarded to J. J. Newman, of Providence. It will be of earth with a stone lining, and will have a capacity of 25,000,000 galls. It is to be completed by January, 1889.

Water Works.—*Fort Myers, Va.*—The following proposals for increasing the water supply at Fort Myers, Va., were opened August 12 by Capt. JOHN F. RODGERS' Depot Quartermaster, U. S. A., Washington, D. C.: J. W. Craig, Baltimore, M. D., $3,000; furnish 20,000 galls. per day, any way. George Zink, Clear Spring, Md., $4 and $3 per ft. for 6-in. and 5-in. pipe, any depth. J. B. White, Baltimore, Md., $1.50 and $2.25 per ft. for gang of wells, 1½-in. and 2-in. pipe; will not guarantee the amount of supply. J. W. Gordon, Washington, D. C.; well 12 ft. diameter, with 9-in. wall, 2-in. timber curbing, $6 per ft. or $10 per ft. if blasted in stone; will guarantee a well with a capacity of 3,000 galls., if water is reached. E. G. Lansdale, Washington, D. C. (A) one or more 5-in. wells, complete for pump, 20,000 galls. per day, near springs $2,000, or $3,000 for 30,000 galls. per day, on high ground. (B) To sink a number of wells, in line or circle, 3 ft. diameter, about 15 ft. deep, each well to have substantial covering and connected with each other by a 2-in. pipe with check valve and strainer at foot, to connect with 4-in. pipe to be carried to well of pump house; 20,000 galls. per day, $1,500. David G. Adelsberger & William Whelan, Baltimore; to construct receiving reservoir, 12 × 20 ft., 13-in. brick wall, covered with octagonal roof; the water to be conveyed from springs to reservoir by 3-in iron pipe; also to erect brick pump house, 14 × 16 ft., steam pump and boiler to be put in house with forcing capacity of 20,000 galls. in 5 hours; also an elevated reservoir on water tower 200 ft. west of the old tower; tank or tower to be 12 ft high, 18 ft. diameter, with a capacity of 21,000 galls., bottom of tank to be about 26 ft. above the ground; also to lay 2,450 ft. of 4-in. cast-iron pipe from old to new tower; extra charge for connecting; all work to be done in a mechanical and workmanlike manner. The bid for this work was $7,746.

Austin, Minn.—The contract for the water-works was let August 13 to the National Iron & Brass Works, Dubuque, Ia.: it calls for two compound, condensing pumping engines, with a daily capacity of 1,000,000 galls. each, two 48-in. steel boilers, a 30 by 50 ft. pump

house, 4 miles of cast-iron pipe and 50 hydrants. The fire supply will be taken from the river, and the domestic supply from wells. LOWETH & CURTIS, of St. Paul, Minn., are the Consulting Engineers.

RAILROADS.

Orange Mountain Cable Ry.—A cable road will be built up Orange Mountain, N. J., by a syndicate which has purchased 300 acres of land on the eastern slope and top of the mountain. It will start from near the Delaware, Lackawanna & Western R. R. station and run to a point in St. Cloud.

East of Chicago.

Existing Roads.—*York Harbor & Beach.* This Maine line, 10 miles in length, running to seaside resorts in the towns of Kittery and York, Me., is now completed, and regular trains are running. The line is in the interest of the Boston & Maine.

Boston & Maine.—The company has offered to sign a contract with the citizens of Laconia, N. H., forfeiting $100,000, if the line from Alton Bay to that place is not completed within two years.

Chicago & Northwestern.—The branch from Felch Mountain to Republic, Mich., for which surveys were made last year, is to be put under construction next season.

Milwaukee & Northern.—The extension from Iron Mountain to Republic is nearly ready for the running of trains. Next year the line is to be extended to Champion, and ultimately on to Ishpeming and Marquette.

Western Maryland.—A project is under consideration for building a branch from the Baltimore & Harrisburg to Manchester, Carroll Co., Md. GEO. A. SHOWER, of that place, is interested.

Hartford & Connecticut Western.—The branch authorized by the last legislature to be built from Tariffville to the State line in Suffield, will be put under construction shortly and will be built to Springfield, Mass.

Pennsylvania.—It is again reported that an extension is to be built soon from Wilkesbarre to Scranton, 18 miles, and that the real estate for terminals at the latter place has been purchased. It is also hinted that the line will be eventually extended further to form the direct route from Western Pennsylvania to New England *via* the Poughkeepsie bridge.

Ontario & Sault Ste. Marie.—A Philadelphia report is to the effect that L. M. SHUTE, of that city, is to begin the construction of this line soon. The line has been located from Cornwall to Perth and Ottawa, and preliminary surveys have been made to Sault Ste. Marie.

Beauharnois Junction.—Ground has been broken on this Canadian line, and the road is to be completed before cold weather from St. Martine to Valleyfield, 23 miles. J. M. SHANLY is Chief Engineer, and JAMES WRIGHT, Contractor.

New Projects and Surveys.—*Castine & Bangor.*—A preliminary survey of this Maine line has resulted in finding a route very favorable to easy construction.

Canada & St. Louis.—This is the new title of the Indiana & Southwestern project, under consideration at Goshen, Ind.

East Wareham & Onset Bay.—This line in the town of Wareham, Mass., is projected in the interest of the Onset Bay Grove Association. The line, which is 1¼ miles in length, has been surveyed ready for construction, and capital and right of way are all secured. Contracts will be let in September. GEO. ROBBINS of Fitchburg is President. The line will eventually be continued two miles to connect with the Old Colony near Buzzard's Bay.

Iberville, Dunham & Clarenceville.—The surveys of this Canadian line, 65 miles in length, will begin Sept. 5, and contracts will be let at the opening of next season. Col. GEO. A. AYER, St. Albans, Vt., is Chairman of the Committee on Construction.

New York & Boston Rapid Transit.—As stated in our note of last week, this line is being pushed with good prospects of success. The company reports four surveying corps, comprising 50 to 60 men, now engaged on the line, and that location will be complete ready for the letting of contracts by Aug. 30.

Upper Coos.—This proposed line in northern New Hampshire has come under a new management. FRANK JONES and C. A SINCLAIR of Portsmouth, N. H. are at the head of the new company.

Chicago & Canada Pacific.—This Michigan road is proposed from Vicksburgh to the Indiana State line, about 40 miles. Surveys have been made from Vicksburgh to Three Rivers, and some work has been done obtaining right of way. WARREN J. WILLITS, Three Rivers, Mich., is Secretary.

Southern.

Existing Roads.—*Illinois Central.*—The preliminary survey is completed of the line from Jackson, Tenn., *via* Brownsville to Memphis. The report of the engineers will be submitted to the board of directors, and action concerning the construction of the line will be taken early in September.

South Florida.—Work on the extension from Tampa to Black Point, 12 miles, is making rapid headway, and the wharves and warehouses under construction at the latter place are also making good progress. All the piling used is creosoted, a necessity for permanent works in the Gulf waters.

Birmingham & Atlantic Air Line.—The contractors on this line are making rapid progress and it is thought that 110 miles will be ready for the ties by Oct. 1. This is on the Georgia division of the line between Savannah and Macon.

Savannah, Florida & Western.—Extensive improvements are in progress on this road. A large amount of 60-lb. steel rail is being laid and the wooden bridges are being replaced by iron.

New Projects and Surveys.—*Birmingham & Northwestern.*—This line has been surveyed from Birmingham, Ala., to Corinth, Miss., about 200 miles. T. R. M. TALCOTT, of Mobile, is President, H. TACON is Secretary & Treasurer.

Cairo & Memphis.—It is stated that a project is on foot for a line between these two points and that a survey is soon to be made. One J. H. WILLIAMS is reported as making investigations at Memphis, and as claiming that the project was backed by "a syndicate of New York capitalists."

Paris, Frankfort & Georgetown.—The $250,000 bonus voted this company by Bourbon county, Ky., will probably ensure the early construction of the line. Hon. WM. LINDSAY, of Frankfort, is President.

Savannah, Dublin & Western Short Line.—The second preliminary survey of this Georgia road is nearly completed and has been run parallel to the Hawkinsville branch, east of the Tennessee, Virginia & Georgia. In connection with the notes we have given in recent numbers of the enthustastic greeting which southern hospitality gives to weary knights of the transit, the following extract regarding the luck of the party making the survey of this line at Cochran, Ga., is quite apropos: "The party worked till near night, accompanied through town by a large delegation of citizens, and met at the Grimsley Hotel, where at 8 o'clock they were handsomely entertained by some fifty of the citizens."

The Northwest.

Existing Roads.—*Forest City & Watertown.*—This Dakota line is projected from Forest City, *via* Appomatox and Northville, to Watertown, about 160 miles. The work on the line is light and the only bridge of size is across the James river. Surveys were made and right of way obtained last season, and about $300,000 capital has been secured with which the company is pushing work on the grading, and has finished about eight miles of roadbed. R. M. SPRINGER, of Forest City, is President, and F. G. BROOKS, Chief Engineer.

St. Louis, Alton & Terre Haute.—The extension from Marion to New Burnside, Ill., a distance of thirty miles, is making good progress under contractor N. W. IRISH. The grading is now completed from Marion to Creel Springs, about 10 miles. It is probable that eventually the line will be extended from New Burnside into the State of Kentucky.

Chicago, Milwaukee & St. Paul.—The line from Albany to New Glarus, Wis., is about ready for passenger traffic. The line will probably be extended beyond New Glarus at an early date.

Chicago, Burlington & Quincy.—The latest scheme in which the Chicago, Burlington & Northern managers are interesting themselves is the Winona & Southwestern, now under survey from Winona, Minn., to Mason City, Ia. It is proposed that the Burlington company take hold of this project, for which large subsidies are already voted, and build the line to Mason City. From this point control would be secured of the Mason City & Fort Dodge, and its projected extension to Council Bluffs would be pushed to early completion.

Minneapolis, Sault Ste. Marie & Atlantic.—It is hoped to complete the tracklaying on the gap between Minneapolis and Turtle Lake by Sept. 1. Work is also being pushed all along the line from Rhinelander east, and the total track on the line is now nearly 350 miles.

Illinois Central.—It is reported that this company contemplates an extension to the coal mines in Clay county, Indiana, a territory now monopolised by the Chicago & Eastern Illinois.

New Projects and Surveys.—*Des Moines & Bismarck.*—The newspapers of Bismarck, Dak., are greatly exercised over the rumor of a project for a great northwest and southeast air line which is being agitated at Des Moines, Ia. It is stated that "surveys will be made this fall and work will commence all along the line in the spring."

Omaha & Yankton.—This Nebraska project continues to be agitated, and it is thought that the company now has sufficient backing to carry the project at least to the stage of preliminary survey. HARVEY N. SHEPARD, of Boston, Mass., is President.

Illinois Valley & Northern.—Work on this Illinois line through La Salle & Peru is to be pushed this fall. J. C. OSGOOD is interested.

The Southwest.

Existing Roads.—*Gulf, Colorado & Santa Fé.*—On the line from Cleburne to Weatherford, Tex., tracklaying is making good progress and it is expected to complete the line by Sept. 15. The line crosses the Fort Worth & Rio Grande at Cresson.

Kansas City, St. Joseph & Council Bluffs.—It is stated that the fast growing traffic will make the double tracking of the line from St. Joseph to Kansas City an early necessity. The Missouri river bridge at Rulo, Neb., will be completed by Sept. 15, and will make a large addition to the present heavy traffic.

Cape Girardeau Southwestern.—The Brownwood Northwestern road is completed and in operation to Zalma, Bollinger county, Mo. The line opens up a heavily timbered region and will soon be extended beyond Zalma.

Central Missouri.—The surveys are to be put under way at once for the portion of the line from St. Charles to St. Louis. Tracklaying is making rapid progress on the portion of the line already under construction.

Kansas City, Fort Scott & Gulf.—The people of Bentonville, Ark., are negotiating for an extension from Joplin, Mo., to that place. Should the line be built it would probably be extended to Little Rock or Fort Smith.

New Projects and Surveys.—*St. Joseph & Santa Fe.*—This company has been incorporated in Missouri to build a narrow gauge road from a point on the Missouri river, opposite Atchison, Kan., to a connection with the Chicago, Santa Fé & California road in Carroll county, a distance of 97 miles. W. A. MCDONALD, of St. Joseph, and D. A. HARVEY, of Topeka, are among the incorporators.

Atchison Belt Railroad & Bridge Co.—Incorporated by JOHN M. PRICE and others, of Atchison, Kan.

Leavenworth & Denver Short Line.—This company has been chartered in Kansas and proposes a line from Leavenworth to the west line of the State, about 430 miles, and thence to Denver, Col. Among the incorporators are JAS. N. BURNS, of St. Joseph, Mo., and THOS. A. GABRIGUES, of Leavenworth, Kan.

New Orleans, Natchez & Fort Scott.—Gen. JOHN H RICE and other officers of this road are hard at work obtaining subsidies and right-of-way along the line of this road through Arkansas and Louisiana, and with a very good degree of success. Contracts will probably be let this fall and the work will be pushed through the winter months.

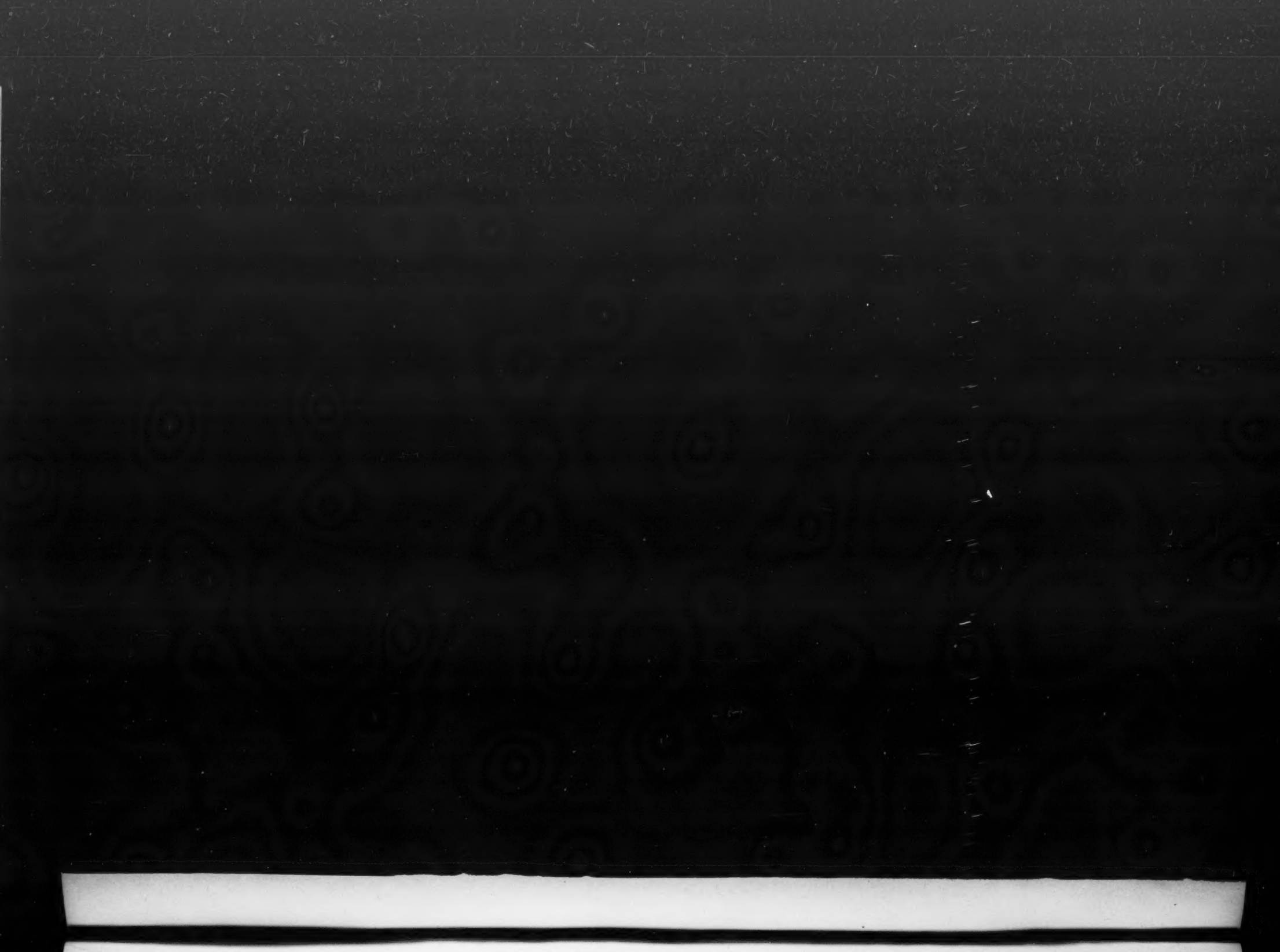
Rocky Mountain and Pacific.

Existing Roads.—*Esquimalt & Nanaimo.*—This line is situated the farthest Northwest of any railroad on this continent. It is located on Vancouver Island and extends from Victoria to Wellington, a distance of 78 miles. The last section of the line, from Nanaimo to Wellington, 5 miles, was finished and opened for traffic a month ago. The remainder of the line was completed last year. The line taps the Wellington coal mines, the property of DUNSMUIR & SONS. R. DUNSMUIR is President, and JOSEPH HUNTER, of Victoria, Chief Engineer and General Manager.

Denver & Rio Grande.—The contractors are "rustling" on the extension to Aspen and Glenwood. Track is laid to within 12 miles of Glenwood, and with the completion of the tunnel near that place the line will be finished and opened for business, it is thought by Sept. 15.——The preliminary survey of the San Juan line from Durango to Rico has been completed, and the distance by the route taken is 82 miles. This is shorter by eight miles than the line which was surveyed by the company some years ago.——Whether the people of Ouray or the boomers of the new town site of Chipeta, the terminus of the present contract for the extension from Montrose, will be the winners in the present rivalry for the terminus of the Montrose extension is as yet uncertain. The advantage, however, seems to lie with Ouray, provided they can raise the $35,000 asked by the company to insure the extension to that point.

Northern Pacific.—A preliminary survey has just been completed for a branch running from a point 40 miles east of Tacoma to the Snogualime iron mines, a distance of 20 miles.

Denver, Utah & Pacific.—Surveys have been made, and right of way secured for the proposed extension to Greeley, Col.; and the people of that place have subscribed the amount asked.——The work is about completed on a short branch running to the sandstone quarries near Lyons, Col.

New Projects and Surveys.—*Baker City & Granite.* The preliminary survey of this Oregon line is in progress under direction of E. H. MIX, of Baker City, the Chief Engineer.

Utah & Wyoming Eastern.—This long delayed project, headed by J. D. NEGUS, of Salt Lake City, is rumored to be again under consideration, and that its franchise and surveys are to be taken up by a large Eastern corporation, perhaps the Illinois Central (?) and the line to be put under construction at once.